PROPOSED

INTERIM MEASURES/INTERIM REMEDIAL ACTION PLAN AND DECISION DOCUMENT

903 PAD, MOUND, and EAST TRENCHES AREAS

OPERABLE UNIT 2

U S DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado

December, 1989

Rockwell International
Aerospace Operations
Rocky Flats Plant

Volume I - Text

DRAFT

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903 PAD MOUND AND EAST TRENCHES AREAS OPERABLE UNIT 2

ROCKY FLATS PLANT GOLDEN COLORADO

DECEMBER 1 1989

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TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Contınued)

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

LIST OF FIGURES

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

TABLE OF CONTENTS
(Continued)

LIST OF TABLES
(Continued)

GLOSSARY OF ACRONYMS

ACRONYM	MEANING
ARAR	Applicable or Relevant and Appropriate Requirements
BAT	Best Available Technology
BDAT	Best Demonstrated Available Technology
BDL	Below Detection Limits
CAA	Clean Air Act
CCl_4	carbon tetrachloride
CCR	Colorado Code of Regulations
CDH	Colorado Department of Health
CEARP	Comprehensive Environmental Assessment and Response Program
CEDE	Committed Effective Dose Equivalent
CERCLA	Comprehensive Environmental Response Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
$CHCl_3$	chloroform
CMS/FS	Corrective Measures Study/Feasibility Study
CWA	Clean Water Act
1 1 DCA	1 1 dichloroethane
1 2 DCA	1 2 dichloroethane
1 1 DCE	1 1 dichloroethene
1 2 DCE	1 2 dichloroethene
DOE	Department of Energy
DOT	Department of Transportation
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
ER	Environmental Restoration Program
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
FR	Federal Register
FWPCA	Federal Water Pollutant Control Act
GAC	Granular Activated Carbon
GOCO	Government Owned Contractor Operated
GPM	Gallons Per Minute
GWPS	Ground Water Protection Standards
HDPE	High Density Polyethylene
HEC	Health Effects Criterion

ACRONYM	MEANING
HS&E	Health Safety and Environment
HSWA	Hazardous and Solid Waste Amendments of 1984
IM/IRA	Interim Measures/Interim Remedial Action
JSA	Job Safety Analysis
KW HR	Kilowatt Hour
LDR	Land Disposal Restrictions
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NCP	National Contingency Plan
NEPA	National Environmental Policy Act of 1969
NPDES	National Pollutant Discharge Elimination System
OSA	Operational Safety Analysis
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethene
PEL	Permissible Exposure Limits
POTW	Publicly Owned Treatment Works
PPM	Parts Per Million
PVC	polyvinyl chloride
PWF	Present Worth Factor
RAAMP	Radioactive Ambient Air Monitoring Program
RCRA	Resource Conservation and Recovery Act of 1976
RfD	Reference Dose
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RFP	Rocky Flats Plant
RI/FS	Remedial Investigation/Feasibility Study
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SWMU	Solid Waste Management Unit
TBC	To Be Considered
1 1 1 TCA	1 1 1 trichloroethane
TCL	Target Compound List
TCE	trichloroethene
TDS	Total Dissolved Solids
TSCA	Toxic Substances Control Act
USC	United States Code
USFWS	United States Fish and Wildlife Service
UV/peroxide	Ultraviolet/peroxide
VOCs	Volatile Organic Compounds

SECTION 1 0

INTRODUCTION

1 1 BACKGROUND

The Department of Energy (DOE) wishes to pursue interim remedial action at the 903 Pad Mound and East Trenches Areas now termed Operable Unit No 2 at the Rocky Flats Plant (RFP) In accordance with the Resource Conservation and Recovery Act of 1976 (RCRA) as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA) and the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) this Interim Measures/Interim Remedial Action (IM/IRA) will be conducted to minimize the migration of hazardous substances via ground water from areas that pose a potential long term threat to the public health and environment DOE is implementing this IM/IRA Plan because of the length of time it typically takes to finalize a RCRA Facility Investigation/Remedial Investigation (RFI/RI) and Corrective Measures Study/Feasibility Study (CMS/FS) Furthermore pursuant to the Agreement in Principle between the DOE and the Colorado Department of Health (CDH) entered into in June 1989 it was agreed that DOE will initiate ground water cleanup the 903 Pad Mound and East Trenches Areas in January 1990 or as soon as the regulatory process will allow

Organic and inorganic contamination of Operable Unit 2 has resulted from past operational practices no longer permitted under current regulations There is no immediate threat to public health and the environment posed by ground water contamination associated with these areas because the affected ground water is contained within the plant boundary However an unacceptable risk could be posed to the public should this contamination migrate downgradient beyond the plant boundary

Rockwell International has prepared this IM/IRA Plan to identify screen and evaluate appropriate interim remedial action alternatives and select the preferred interim remedial action for the Area This IM/IRA Plan has been prepared to conform with the requirements for an Engineering Evaluation/Cost Analysis (EE/CA) as defined in the proposed National Contingency Plan [40 CFR 300 415(b)(4)] It also conforms to the National Environmental Policy Act (NEPA) of 1969 as implemented by regulations promulgated by the President s Council on Environmental Quality (40 CFR 1500 1508) and DOE Guidelines (10 CFR 1021 DOE Order 5440 1c and 5400 4 DOE/EV 0132)

In March 1987 a Phase I remedial investigation under the Environmental Restoration (ER) Program [formerly known as the Comprehensive Environmental Assessment and Response Program (CEARP)] began at Operable Unit 2 The investigation consisted of the preparation of detailed topographic maps radiometric and organic vapor screening surveys surface geophysical surveys a soil gas survey a boring and well completion program soil sampling and ground and surface water sampling Phase I field activities were completed at Operable Unit 2 during 1987 and a draft RI report was submitted to EPA and CDH on December 31 1987 (Rockwell International 1987a) Phase I data did not allow adequate definition of the nature and extent of contamination for the purpose of conducting a feasibility study of remedial alternatives A Phase II RI Sampling Plan that presents the details and rationale for further field work based on results presented in the draft RI report was submitted to the regulatory agencies in June 1988 (Rockwell International 1988a) A draft final sampling plan incorporating agency comments will be submitted to the regulatory agencies in December 1989

1 2 IM/IRA PLAN ORGANIZATION

Section 2 0 (Site Characterization) of this plan describes the potentially affected environment associated with the proposed IM/IRA and the results of the previous investigation at Operable Unit 2 Most of the information included in Section 2 0 has been derived from the draft RI report and draft Phase II Sampling Plan although chemical data have been updated to include all data collected through second quarter 1989

Section 3 0 identifies the objectives of the IM/IRA applicable or relevant and appropriate requirements (ARARs) and applicable environmental regulations The objectives and ARARs define the criteria used to identify and evaluate IM/IRA options

Section 4 0 identifies technically feasible IM/IRA alternatives that address the objectives and screens these alternatives based on implementability effectiveness and costs

Section 5 0 summarizes the detailed analysis performed in Section 4 0 and Section 6 0 presents the preferred IM/IRA

Sections 7 0 and 8 0 incorporate NEPA documentation regarding the environmental effects of the preferred IM/IRA and other IM/IRA alternatives respectively This analysis is intended to provide sufficient information to aid in a NEPA determination of environmental impacts of the proposed interim remedial action The scope of the analysis does not include evaluation of the existing operations at the Rocky Flats Plant final remedial actions at Operable Unit 2 or subsequent remedial actions at other locations of the Rocky Flats Plant The environmental impacts of plant operation were previously analyzed in the final Environmental Impact Statement (DOE 1980) NEPA documentation for final remedial actions at Operable Unit 2 and any subsequent remedial actions at other locations of the Rocky Flats Plant will be provided in future documents

Volume II of this IM/IRA Plan contains the alluvial and bedrock ground water quality data for Operable Unit 2

SECTION 2 0

SITE CHARACTERIZATION

2 1 SITE DESCRIPTION AND BACKGROUND

2 1 1 Location and Facility Type

The Rocky Flats Plant (RFP) is located in northern Jefferson County Colorado approximately 16 miles northwest of downtown Denver (Figure 2 1) The Plant site consists of approximately 6 550 acres of federally owned land in Sections 1 through 4 and 9 through 15 of T2S R70W 6th principal meridian Plant buildings are located within an area of approximately 400 acres known as RFP security area The security area is surrounded by a buffer zone of approximately 6 150 acres

The RFP is a government owned contractor operated (GOCO) facility It is part of a nation wide nuclear weapons research development and production complex administered by the Albuquerque Operations Office of the U S Department of Energy The operating contractor for the Rocky Flats Plant is Rockwell International The facility manufactures components for nuclear weapons and has been in operation since 1951 RFP fabricates components from plutonium uranium beryllium and stainless steel Production activities include metal fabrication machining and assembly Both radioactive and nonradioactive wastes are generated in the process Current waste handling practices involve on site and off site recycling of hazardous materials and off site disposal of solid radioactive materials at another DOE facility

The RFP is currently an interim status Resource Conservation and Recovery Act (RCRA) hazardous waste treatment/storage facility In the past both storage and disposal of hazardous and radioactive wastes occurred at on site locations Preliminary assessments conducted under Phase 1 of the ER Program identified some of the past on site storage and disposal locations as potential sources of environmental contamination

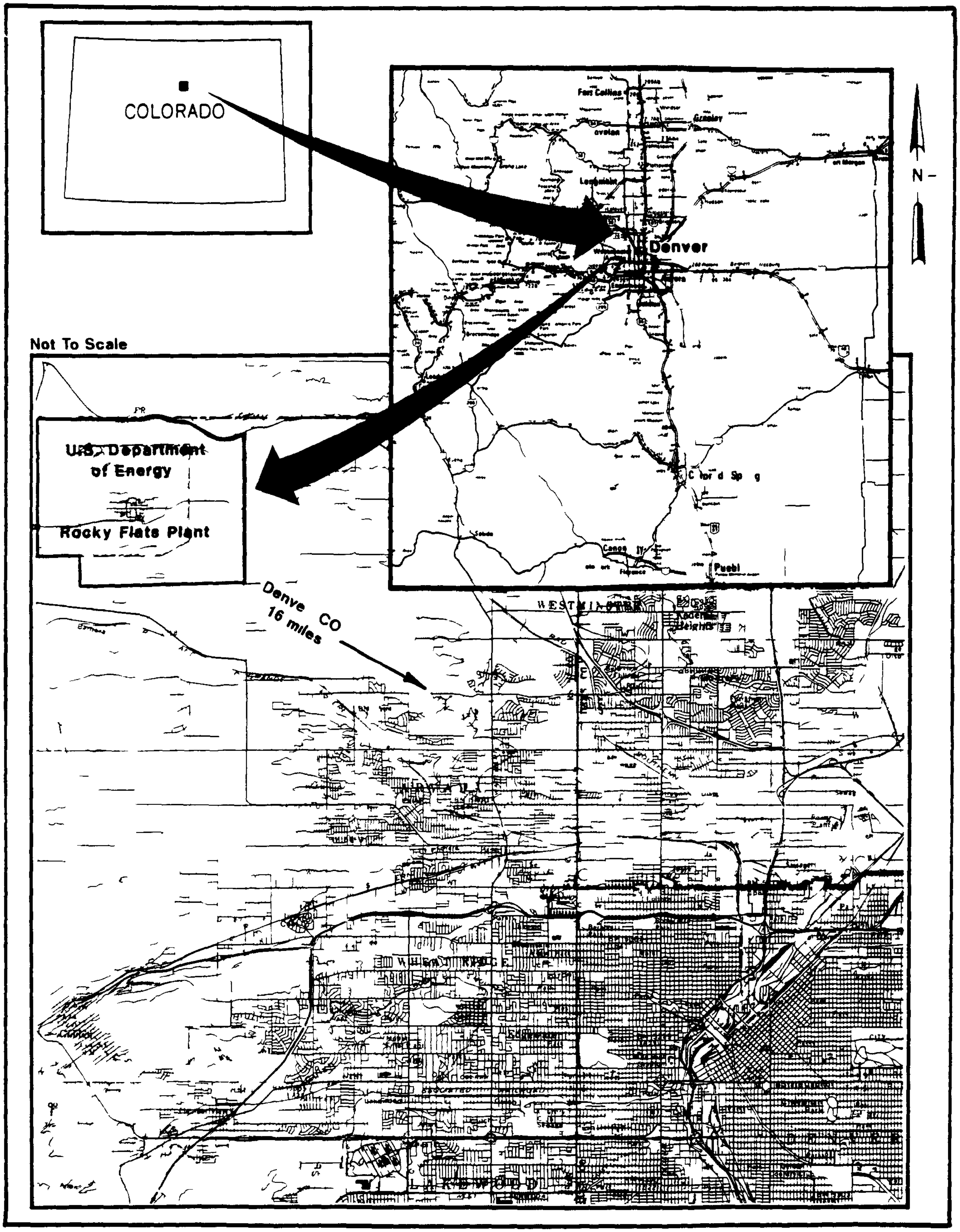


FIGURE 2 1 LOCATION OF ROCKY FLATS PLANT

2 1 2 Operable Unit 2 Description

There are 20 sites designated as solid waste management units (SWMUs) which comprise the 903 Pad Mound and East Trench Areas These sites are known collectively as Operable Unit 2 and are located east southeast of the RFP (Figure 2 2)

2 1 2 1 903 Pad Area

Five sites are located within the 903 Pad Area These sites are

903 Drum Storage Site (SWMU 112)

903 Lip Site (SWMU 155)

Trench T 2 (SWMU 109)

Reactive Metal Destruction Site (SWMU 140) and

Gas Detoxification Site (SWMU 183)

Presented below are brief descriptions of each of these sites

1 **903 Drum Storage Site (SWMU 112)** The site was used from 1958 to 1967 to store drums containing radioactively contaminated used machine cutting oil The drums contained oils and solvents contaminated with plutonium or uranium Most of the drums contained lathe coolant consisting of mineral oil and carbon tetrachloride (CCl_4) in varying proportions However an unknown number of drums contained hydraulic oils vacuum pump oils trichloroethene (TCE) tetrachloroethene (PCE) silicone oils and acetone (Rockwell International 1987a) Ethanolamine was also added to new drums after 1959 to reduce the drum corrosion rate All drums were removed by 1968

After the drums were removed efforts were undertaken to scrape and move the plutonium contaminated soil into a relatively small area cover it with fill material and top it with an asphalt containment cover This remedial action was completed in November 1969 An estimated 5 000 gallons of liquid leaked into the soil during use of the drum storage site The liquid was estimated to contain 86 grams of plutonium (Rockwell International 1987a)

2 **903 Lip Site (SWMU 155)** During drum removal and cleanup activities associated with the 903 Drum Storage Site winds distributed plutonium beyond the pad to the south and east Although some plutonium contaminated soils were removed radioactive contamination is still present at the 903 Lip Site in the surficial soils

3 **Trench T 2 (SWMU 109)** This trench was used prior to 1968 for the disposal of sanitary sewage sludge and flattened drums contaminated with uranium and plutonium

4 **Reactive Metal Destruction Site (SWMU 140)** This site was used during the 1950s and 1960s primarily for the destruction of lithium metal (DOE 1986) Small quantities of other reactive metals (sodium calcium and magnesium) and some solvents were also destroyed at this location (Rockwell International 1987a)

5 **Gas Detoxification Site (SWMU 183)** Building 952 located south of the 903 Drum Storage Site was used to detoxify various bottled gases between June 1982 and August 1983

2 1 2 2 Mound Area

The Mound Area is composed of four sites These are

Mound Site (SWMU 113)

Trench T 1 (SWMU 108)

Oil Burn Pit No 2 (SWMU 153) and

Pallet Burn Site (SWMU 154)

These sites are described individually below

1 **Mound Site (SWMU 113)** The Mound Site contained approximately 1 405 drums filled with depleted uranium and beryllium wastes The wastes were mostly solid however some drums were filled with lathe coolant and some drums may have contained Perclene a brand name of tetrachloroethene (Sax and Lewis 1987) Cleanup of the Mound Site was accomplished in 1970 and the materials removed were packaged and shipped to an off site DOE facility as radioactive waste Subsequent surficial soils sampling in the vicinity of the excavated Mound Site indicated 0 8 to 112 5 disintegrations per minute per gram (d/m/g) alpha activity This radioactive contamination is thought to have come from the 903 Drum Storage Site rather than from the Mound Site (Rockwell International 1987a)

2 **Trench T 1 (SWMU 108)** The trench was used from 1952 until 1962 and contains approximately 125 drums filled with depleted uranium chips coated with lathe coolant The drums are still present in this trench

3 **Oil Burn Pit No 2 (SWMU 153)** Oil Burn Pit No 2 is actually two parallel trenches which were used in 1957 and from 1961 to 1965 to burn 1 083 drums of oil containing uranium (Rockwell International 1987a) The residues from the burning operations and some flattened drums were covered with backfill Cleanup operations were performed in the 1970s (Rockwell International 1987a)

4 **Pallet Burn Site (SWMU 154)** An area southwest of Oil Burn Pit No 2 was reportedly used to destroy wooden pallets in 1965 The types of hazardous substances or radionuclides that may have been spilled on these pallets is unknown Clean up actions were performed in the 1970s (DOE 1986)

2 1 2 3 East Trenches Area

The East Trenches Area consists of nine burial trenches and two spray irrigation areas

The trench numbers and their respective SWMU designations are

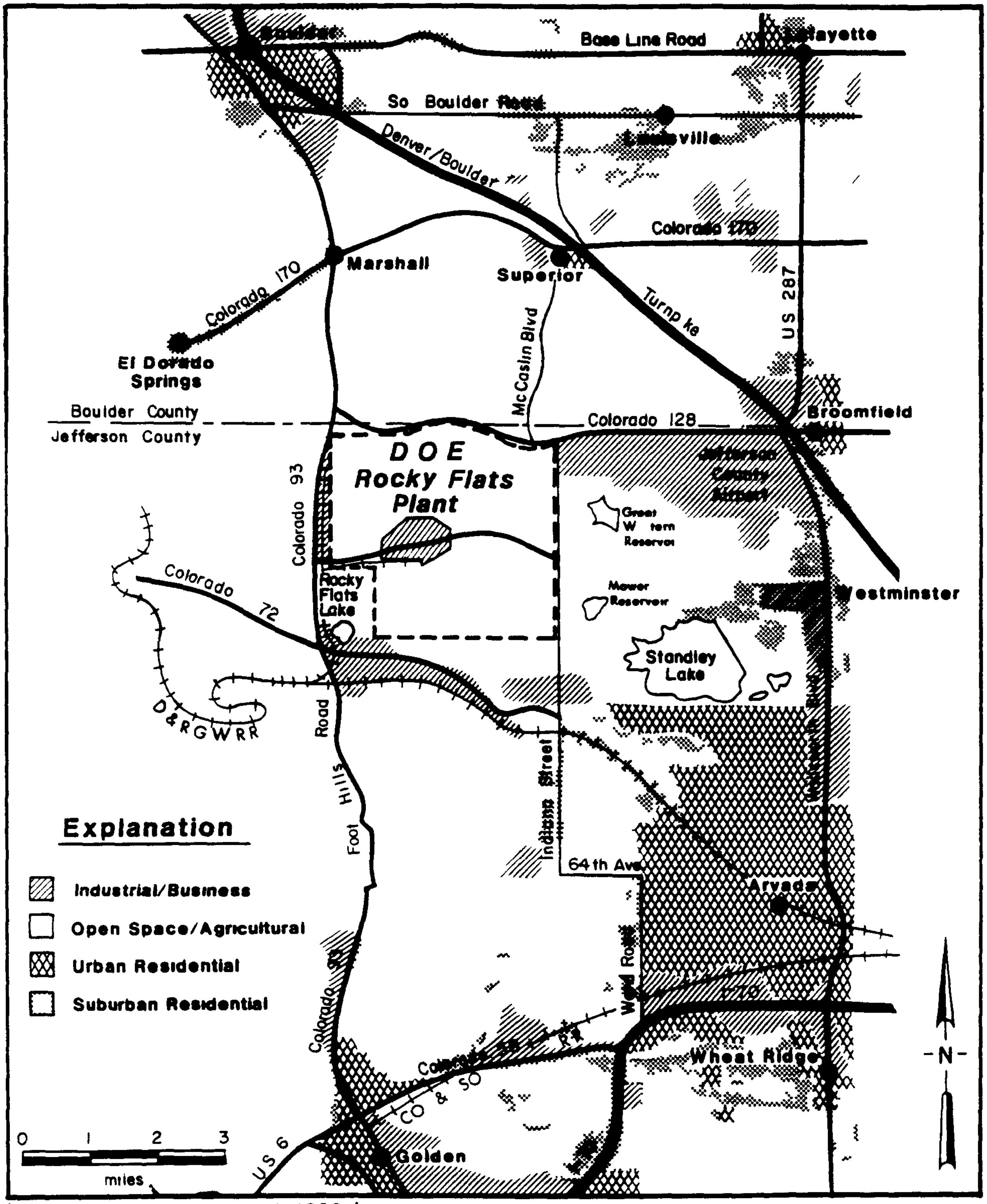
Trench T 3	SWMU 110
Trench T 4	SWMU 111 1
Trench T 5	SWMU 111 2
Trench T 6	SWMU 111 3
Trench T 7	SWMU 111 4
Trench T 8	SWMU 111 5
Trench T 9	SWMU 111 6
Trench T 10	SWMU 111 7
Trench T 11	SWMU 111 8

Trenches T 3 T 4 T 10 and T 11 are situated north of the east access road and trenches T 5 through T 9 are located south of the east access road The trenches were used from 1954 to 1968 for disposal of depleted uranium flattened depleted uranium and plutonium contaminated drums and sanitary sewage sludge The wastes have not been disturbed since their burial

SWMU numbers 216 2 and 216 3 are areas used for spray irrigation of sewage treatment plant effluent These areas have been designated as solid waste management units because of the potential for chromium contamination that resulted from a Plant spill of chromic acid that entered the sanitary sewers on February 23 1989 Based on results of sampling after the February spill leachable chromium concentrations in soils were significantly below the RCRA Extraction Procedure (EP) Toxicity limits (Rockwell International 1989b)

2 1 3 <u>Surrounding Land Use and Population Density</u>

The Rocky Flats Plant is located in a rural area (Figure 2 3) There are eight public schools within six miles of RFP The nearest educational facility is the Witt Elementary School which is approximately 2 7 miles east of the RFP buffer zone The closest hospital to RFP is Centennial Peaks Hospital located approximately seven miles northeast The closest



(after Rockwell International, 1986a)

Figure 2 3

Land Use in the Vicinity of Rocky Flats Plant

park and recreational area is the Standley Lake area which is approximately five miles southeast of the RFP site Boating picnicking and limited overnight camping are permitted Several other small parks exist in communities within ten miles of RFP The closest major park Golden Gate Canyon State Park located approximately 15 miles to the southwest provides 8 400 acres of general camping and outdoor recreation Other national and state parks are located in the mountains west of RFP but all are more than 15 miles away

Some of the land adjacent to RFP is zoned for industrial development Industrial facilities within five miles of RFP include the TOSCO laboratory (40 acre site located two miles south) the Great Western Inorganics Plant (two miles south) the Frontier Forest Products yard (two miles south) the Idealite Lightweight Aggregate Plant (2 4 miles northwest) and the Jefferson County Airport and Industrial Park (990 acre site located 4 8 miles northeast)

Several ranches are located within ten miles of RFP primarily in Jefferson and Boulder Counties They are operated to produce crops raise beef cattle supply milk and breed and train horses According to the 1987 Colorado Agricultural Statistics 20 758 acres of crops were planted in Jefferson County (total land area of approximately 475 000 acres) and 68 760 acres of crops were planted in Boulder County (total land area of 405 760 acres) Crops consisted of winter wheat corn barley dry beans sugar beets hay and oats Livestock consisted of 5 314 head of cattle 113 hogs and 346 sheep in Jefferson County and 19 578 head of cattle 2 216 hogs and 12 133 sheep in Boulder County (Post 1989)

Approximately 50 percent of the area within ten miles of RFP is in Jefferson County The remainder is located in Boulder County (40 percent) and Adams County (10 percent) According to the 1973 Colorado Land Use Map 75 percent of this land was unused or was used for agriculture Since that time portions of this land have been converted to housing with several new housing subdivisions being started within a few miles of the buffer zone One such subdivision is located south of the Jefferson County Airport and several are located southeast of RFP

A demographic study using 1980 census data shows that approximately 1 8 million people lived within 50 miles of RFP in 1980 (Rockwell International 1987b) Approximately 9 500 people lived within five miles of RFP in 1980 The most populous sector was to the southeast toward the center of Denver This sector had a 1980 population of about 555 000 people living between 10 and 50 miles from RFP Recent population estimates registered by the Denver Regional Council of Governments for the eight county Denver Metro region have shown distinct patterns of growth between the first and second halves of the decade Between 1980 and 1985 the population of the eight county region increased by 197 890 a 2 4 percent annual growth rate Between 1985 and 1989 a population gain of 71 575 was recorded representing a 1 0 percent annual increase (the national average) The 1989 population showed an increase of 2 225 (or 0 1 percent) from the same date in 1988 (DRCOG 1989)

2 2 AFFECTED AND SENSITIVE ENVIRONMENT

2 2 1 Physical Environment

The natural environment of the Plant and vicinity is influenced primarily by its proximity to the Front Range of the Rocky Mountains The Plant is directly east of the north south trending Rocky Mountains with an elevation of approximately 6 000 feet above sea level Rocky Flats Plant is located on a broad eastward sloping plain of overlapping alluvial fans developed along the Front Range The fans extend about five miles in an eastward direction from their origin in the abruptly rising Front Range and terminate on the east at a break in slope to low rolling hills The continental divide is about 16 miles west of the Plant The operational area at the Plant is located near the eastern edge of the fans on a terrace between stream cut valleys (North Walnut Creek and Woman Creek) The Rocky Flats Alluvium (the deposit of coalescing alluvial fans) is exposed at the surface and consists of a topsoil layer underlain by as much as 100 feet of silt clay sand and gravel

The Rocky Flats Plant is situated in a semiarid region averaging 15 inches of annual precipitation Forty percent of the yearly total comes in the spring much of it in the form of snow Of the balance 30 percent is accounted for by summer thunderstorms with the rest falling in the fall (11%) and winter months (19%) Average yearly snowfall averages 85 inches Runoff control structures exist to channel surface water from the Plant to monitoring ponds These structures are sized to accommodate the 100 year storm event which is equivalent to four inches of rain in a six hour period

Mineral resources occurring in the vicinity of RFP include sand gravel crushed rock clay coal and uranium There are no known clay coal or uranium deposits within the RFP buffer zone however these commodities are mined in the region within 20 miles of the plant The Schwartzwalder Uranium Mine is located approximately four miles southwest of RFP The mine has been the largest producer of vein type uranium ore in Colorado and ranks among the six largest of this type in the United States (DOE 1980) Active sand and gravel mines lie within the buffer zone boundaries There is a currently inactive aggregate processing facility adjacent to the northwest corner of the buffer zone which is scheduled to be reopened in 1989 Oil and natural gas production is also active in nearby northwest Adams County and east central Boulder County

There are four main drainages from the plant property North Walnut South Walnut Rock and Woman Creeks All are intermittent streams which provide drinking water and irrigation water There are a number of ditches crossing the area as well conveying water collected off site to other areas the Plant Walnut Creek or Woman Creek Until late 1974 plant waste water had been discharged to Walnut Creek and until 1975 filter backwash from the raw water treatment plant went into Woman Creek All process waste water is now either recycled or disposed of through evaporation Sanitary waste water is discharged in accordance with the NPDES permit effluent limitations when on site spray irrigation is not feasible

2 2 2 Operable Unit 2 Geology

The following geologic information is based on Rockwell International s Draft RI Report and the reader is referred to this report for additional details (Rockwell International

1987a)

2 2 2 1 Surficial Materials

Surficial materials at the 903 Pad Mound and East Trench Areas consist of the Rocky Flats Alluvium colluvium and valley fill alluvium uncomformably overlying bedrock All of the study areas are situated on a terrace of Rocky Flats Alluvium that extends eastward from the Plant The Rocky Flats Alluvium consists of a poorly to moderately sorted poorly stratified deposit of clays silts sands gravels and cobbles A portion of the 903 Pad Area extends south off the terrace toward the South Interceptor Ditch Colluvium is present on the hillside south of the 903 Pad and East Trenches Area and in the South Walnut Creek drainage north of the Mound Area

Buried valleys and ridges eroded into the top of bedrock are present at the base of the Rocky Flats Alluvium One such paleovalley is located north of the 903 Pad Area along Central Avenue (Figure 2 2) The paleovalley is approximately 300 feet wide and 2 000 feet long It trends east northeast beneath the east access road and bends to the southeast just south of well 33 87 (see Figure 2 5 for well locations) Near well 32 87 the paleovalley is joined by another paleovalley which is at least 3 000 feet long 400 feet wide and trends northeast toward well 39 86 A 150 feet wide paleoridge located east of well 15 87 separates the two paleo valleys Another paleoridge occurs beneath the northern edge of the Rocky Flats Alluvium terrace east of the Mound Area and north of the East Trenches Area (well 35 87)

2 2 2 2 Bedrock Materials

The Cretaceous Arapahoe Formation underlies surficial materials at the 903 Pad Mound and East Trenches Areas Sixteen wells were completed in various zones within the bedrock during the 1987 drilling program The Arapahoe Formation consists of fluvial claystones with interbedded lenticular sandstones siltstones and occasional lignite deposits Contacts between these lithologies are both gradational and sharp

The Arapahoe Formation was deposited by meandering streams which flowed east southeast from the Front Range Uplift (Weimer 1973) The fining upward sandstone sequences within the formation are representative of both laterally accreted point bar deposits and floodplain splay deposits Laterally accreted point bar deposits occur by the slow migration of stream channels and splay deposits are formed by breaching of stream banks during floods (Blatt and others 1980) Siltstone and claystone lithologies are indicative of overbank flood deposits and/or channel fill deposits Overbank flood deposits consist of very fine sand and mud deposited near the stream channel or on the stream flood plain (Blatt and others 1980) Channel fill deposits are formed in channels abandoned by a reduction in stream discharge or by cutoff of a meander (formation of oxbow lakes) (Blatt and others 1980)

Claystone was the most frequently encountered lithology of the Arapahoe Formation immediately below the alluvium/bedrock contact Weathered bedrock was encountered directly beneath surficial materials in all of the boreholes and wells

Saturated sandstones were found in wells 9 87BR 12 87BR 23 87BR and 25 87BR directly below surficial materials and in wells 62 86 11 87BR 14 87BR and 36 87BR near the alluvium/bedrock contact Bedrock wells 40 86 16 87BR 18 87BR 20 87BR 22 87BR 28 87BR 30 87BR and 31 87BR are completed in deeper saturated sandstones The Arapahoe sandstones are generally lenticular and somewhat discontinuous however some of the sandstone units have been correlated for lateral distances as great as 500 feet

2 2 3 Site Hydrology

2 2 3 1 Surface Water

Surface water drainage patterns at the Rocky Flats Plant are shown on Figures 2 2 and 2 4 A discussion of the major surface water features is presented below

South Walnut Creek

The headwaters of South Walnut Creek have been filled during construction of plant facilities As a result flow originates from a buried culvert located west of Building 991 (see Figure 2 2) During the Phase I RI surface water sampling flow in the upper reach of South Walnut Creek was visually estimated at five gallons per minute (gpm) (Rockwell International 1987a) This flow is routed beneath Building 991 in a corrugated metal pipe The discharge from the corrugated metal pipe is augmented by flow from a concrete pipe at a point north of the Mound Area The flow from the concrete pipe (visually estimated at one gpm) originates as seepage from the hillside south of Building 991 and flows into a ditch along the slope The combined flow then enters the South Walnut Creek retention pond system Below the retention ponds South Walnut Creek North Walnut Creek and an unnamed tributary join within the buffer zone before flowing into Great Western Reservoir Great Western Reservoir is located approximately one mile east of this confluence

The South Walnut Creek retention pond system consists of five ponds (B 1 B 2 B 3 B 4 and B 5) that retain surface water runoff and Plant discharges for the purpose of monitoring before downstream release of these waters All flow in the pond system is eventually retained in Pond B 5 where it is monitored for quality before discharge in accordance with the Plant s National Pollutant Discharge Elimination System (NPDES) permit (discharge point 006) Ponds B 1 and B 2 are reserved for spill control surface water runoff or treated sanitary waste of questionable quality Pond B 3 is used as a holding pond for sanitary sewage treatment plant effluent The normal discharge of Pond B 3 is to a spray system located in the vicinity of the East Trenches Ponds B 4 and B 5 receive surface water runoff from the central portion of the Plant and occasional discharges from Pond B 3 The surface water runoff received by Pond B 4 is collected by the Central Avenue Ditch and upper reaches of South Walnut Creek

Woman Creek

Woman Creek is located south of the Plant with headwaters in largely undisturbed Rocky Flats Alluvium Runoff from the southern part of the Plant is collected in the South Interceptor Ditch located north of the creek and delivered downstream to Pond C 2 (see Figure 2 2) Pond C 1 (upstream of C 2) receives stream flow from Woman Creek The discharge from Pond C 1 is diverted around Pond C 2 into the Woman Creek channel downstream Water in Pond C 2 is discharged to Woman Creek in accordance with the Plant NPDES permit (discharge point 007)

Flow in Woman Creek and the South Interceptor Ditch is intermittent During the 1986 and 1987 investigations there was no visible surface flow in Woman Creek downstream of Pond C 2 The intermittent surface water flow observed for Woman Creek and the South Interceptor Ditch is indicative of frequent interaction with the shallow ground water system

2 2 3 2 Ground Water

Ground water occurs in surficial materials (Rocky Flats Alluvium colluvium and valley fill alluvium) and in Arapahoe sandstones and claystones at Operable Unit 2 These two hydraulically connected flow systems are discussed separately below

Ground Water in Surficial Materials

Ground water is present in the Rocky Flats Alluvium colluvium and valley fill alluvium under unconfined conditions Recharge to the water table occurs as infiltration of incident precipitation and as seepage from ditches and creeks In addition retention ponds along South Walnut Creek and Woman Creek recharge the valley fill alluvium Figure 2 5 presents the potentiometric surface of uppermost ground water measured on December 1 1987 and the locations of alluvial and bedrock wells in the vicinity of Operable Unit 2

The shallow ground water flow system is quite dynamic with large water level changes occurring in response to precipitation events and stream and ditch flow For example between mid April and September 1986 water levels in wells 1 86 and 4 86 (completed in valley fill alluvium) dropped more than four and eight feet respectively Alluvial water levels are highest during the months of May and June Water levels decline during late summer and fall and some wells go completely dry at this time of year

Alluvial ground water discharges to seeps springs surface water drainages and subcropping Arapahoe sandstone at Operable Unit 2 Seeps and springs occur along the edge of the Rocky Flats Alluvium terrace (at the alluvium/bedrock contact) and on the side slopes of the terrace Seeps and springs on the terrace side slopes may be due to thinning of colluvial materials Ground water in colluvial materials south of the 903 Pad and East Trenches Areas discharges to the South Interceptor Ditch and ground water in valley fill materials discharges to Woman or South Walnut Creeks

Ground water flow in the Rocky Flats Alluvium is generally from west to east following the buried topography on top of claystone bedrock Because of the bedrock highs beneath the Rocky Flats Alluvium in the East Trenches Area ground water flow is diverted either toward the paleovalleys or off the edge of the Rocky Flats terrace Water diverted toward the paleovalleys flows northeast following the trend of the valleys Ground water flowing toward the terrace edges emerges as seeps and springs at the contact between the alluvium and bedrock (contact seeps) is consumed by evapotranspiration or flows through colluvial materials following topography toward the valley fill alluvium Once ground water reaches the valley fill alluvium it either flows down valley in the alluvium is consumed by evapotranspiration recharges bedrock or discharges to the creek During the driest periods of the year evapotranspiration results in no flow in either the colluvium or the valley fill alluvium

The saturated thickness in surficial materials varied from zero to nine feet for wells 63 86 and 17 87 respectively The absence of alluvial ground water in these areas is due to one of the following conditions

1) discharge of ground water to the surface system (seeps and springs) where bedrock is at or near the ground surface

2) discharge of ground water to the atmosphere as evaporation from the capillary fringe and as transpiration from phyreatophytes or

3) recharge to subcropping bedrock sandstones from alluvial ground water

Wells completed in these areas have been dry moisture content observations from boreholes also indicate unsaturated conditions

Hydraulic conductivity values were developed for surficial materials from drawdown recovery tests performed on 1986 wells during the initial site characterization and from slug tests performed on select 1986 and 1987 wells during the 1987 Phase I RI (Rockwell International 1987a) Values for surficial deposits are discussed in the following paragraphs

For the Rocky Flats Alluvium the geometric mean hydraulic conductivity for all tests is 4×10^{4} centimeters per second (cm/s) or 418 feet per year (ft/year) Based on an average horizontal gradient of 0 02 feet/foot (ft/ft) an assumed effective porosity of 0 1 and a mean hydraulic conductivity of 418 ft/year the average ground water velocity in the Rocky Flats Alluvium is 84 ft/year (Rockwell International 1987a)

The geometric mean hydraulic conductivity based on drawdown recovery tests for the Woman Creek valley fill alluvium is 7×10^{4} cm/s (724 ft/year) No slug tests were performed on wells completed in Woman Creek valley fill Using the same gradient and effective porosity as for the Rocky Flats Alluvium and a mean hydraulic conductivity of 724 ft/year the average ground water velocity in Woman Creek valley fill is 145 ft/year (Rockwell International 1987a)

South Walnut Creek valley fill is less conductive than that along Woman Creek based on lithologic descriptions and hydraulic conductivity tests Using the mean conductivity of $9\ 5 \times 10^{5}$ cm/s (98 ft/year) an effective porosity of 0 1 and an average gradient of 0 02 ft/ft the average flow velocity in South Walnut Creek valley fill is 20 ft/year (Rockwell International 1987a)

The average ground water flow velocities calculated for various surficial materials assume the materials are fully saturated year round However as discussed above portions of the Rocky Flats Alluvium colluvium and valley fill alluviums are not saturated during the entire year Thus dissolved constituents in the shallow flow system do not actually move at the calculated velocities for the entire year

Bedrock Ground Water

The majority of ground water flow in the Arapahoe Formation occurs in the lenticular sandstones contained within the claystones Ground water recharge to sandstones occurs as infiltration from alluvial ground water where sandstones subcrop beneath the alluvium and by leakage from claystones overlying the sandstones Usable ground water occurs in the Arapahoe Aquifer Water in sandstones of the Arapahoe Aquifer are used for irrigation livestock watering and domestic purposes east of RFP

There is a strong downward gradient between ground water in surficial materials and bedrock Vertical gradients range from 0 31 ft/ft between wells 35 86 and 34 86 to 1 05 ft/ft between wells 41 86 and 40 86 These gradients imply a relatively high hydraulic conductivity contrast between the sandstones and claystones which is supported by hydraulic conductivity test results

Flow within individual sandstones is from west to east based on the sandstone correlations between wells 9 87BR and 16 87BR Ground water in well 9 87BR is unconfined but confined conditions exist in well 16 87BR The horizontal gradient between these wells is 0 09 ft/ft

Hydraulic conductivity values for Arapahoe sandstones were estimated from drawdown recovery tests performed in 1986 slug tests performed in 1987 and packer tests performed in 1986 and 1987 Hydraulic conductivity values from drawdown recovery and slug tests are in good agreement however packer test results are approximately two orders of magnitude less than results from the other two test methods The geometric mean hydraulic conductivity from drawdown recovery tests slug tests and packer tests are 4×10^{5} cm/s (41 ft/yr) 8×10^{5} cm/s (83 ft/yr) and 4×10^{7} cm/s (0 4 ft/yr) respectively The drawdown recovery and slug tests are considered more representative of in situ conditions because they were performed after development of the wells

The maximum horizontal ground water flow velocity in sandstone is 75 ft/yr using a hydraulic conductivity of 83 ft/yr an average horizontal gradient of 0 09 ft/ft and an assumed effective porosity of 0 1

The geometry of the ground water flow path in the bedrock is not fully understood at this time because it depends upon the continuity of the sandstones and their interconnection Evaluation of the lateral extent and degree of interconnection of the sandstone units is a primary goal of the Phase II hydrogeologic characterization for Operable Unit 2

2 2 4 Ecology

Within the plant boundaries a variety of vegetation thrives Included are species of flora representative of tall grass prairie short grass plains lower montane and foothill ravine regions with none being on the endangered species list It is evident that the vegetative cover along the Front Range of the Rocky Mountains has been radically altered by human activities such as burning timber cutting road building and overgrazing for many years Since the acquisition of the Rocky Flats Plant property vegetative recovery has occurred as evidenced by the presence of grasses like big bluestem and sideoats grama (two disturbance sensitive species) No vegetative stresses attributable to hazardous waste contamination have been identified (DOE 1980)

The animal life inhabiting the Rocky Flats Plant and its buffer zone consists of species associated with western prairie regions The most common large mammal is the mule deer with an estimated 100 125 permanent residents There are a number of small carnivores such as the coyote red fox striped skunk and long tailed weasel A profusion of small herbivore species can be found throughout the plant and buffer zone consisting of species such as the pocket gopher white tailed jackrabbit and the meadow vole (DOE 1980)

Commonly observed birds include western meadowlarks horned larks mourning doves and vesper sparrow A variety of ducks killdeer and red winged black birds are seen in areas adjacent to ponds Mallards and other ducks frequently nest and rear young on several of the ponds Common birds of prey in the area include marsh hawks red tailed hawks ferruginous hawks rough legged hawks and great horned owls (DOE 1980)

Bull snakes and rattlesnakes are the most frequently observed reptiles Eastern yellow bellied racers have also been seen The eastern short horned lizard has been reported on the site but these and other lizards are not commonly observed The western painted turtle and the western plains garter snake are found in and around many of the ponds (DOE 1980)

2 2 5 Sensitive Environments and Endangered Species

The Endangered Species Act of 1973 (Public Law 93 0205) as amended provides that all federal agencies implement programs for the conservation of listed endangered and threatened species Federal agencies must ensure that actions authorized funded or carried out by them will not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of historical/archaeological features or critical habitats

The U S Fish and Wildlife Service (USFWS) has indicated that the two endangered species of interest in the RFP area are the bald eagle and the black footed ferret (Rockwell International 1988d) Prairie dog towns provide the food source and habitat for ferrets Since there are no prairie dog towns in or near the 881 Hillside Area which is near the 903 Pad Mound and East Trenches the USFWS has determined that ferrets probably do not exist in the investigation area Bald eagles are occasional visitors to the area primarily during migration times Sightings are rare and little suitable habitat occurs on plant site other than some perching locations No nests occur on plant site The proposed action will not adversely affect the bald eagle The USFWS has concurred with these findings subsequent to a field visit on 6/15/88

Other animal species of interest that exist in the RFP area include burrowing owls and Swainson s hawks Cottonwood trees within approximately 1/4 mile of the 903 Pad Mound and East Trenches Areas were investigated to determine if any raptor nests existed and none were found The trees will be reinspected in the spring to ensure that activities do not disturb nesting or raising of young The nearest population of burrowing owls is approximately two miles to the east

The 903 Pad Mound and East Trenches Areas are not used nor intended for use as a public or recreational area nor for the development of any unique natural resource No unique ecosystems were found at RFP during extensive biological studies (DOE 1980)

2 2 6 Wetlands

Consultation with the United States Fish and Wildlife Service (USFWS) and the U S Army Corps of Engineers was conducted in the spring of 1988 Wetlands at the plant site were delineated The proposed action is not located in the delineated wetlands Aerial photography imagery for the 903 Pad Mound and East Trenches Areas was examined for wetlands identification on September 13 1989 followed by limited site inspection Two isolated stands of wetlands vegetation containing common cat tail (*Typha latifolia*) were located primarily within SWMU #140 where groundwater flowing towards the terrace edges emerges as seeps or springs at the contact between the alluvium and bedrock The two areas are less than 20 square feet in size

Wetlands areas have been identified along both the Woman Creek and South Interceptor Ditch drainage areas Evenly spaced drop structures along the South Interceptor Ditch have lowered flow velocities increased sediment accumulation and created fairly dense linear stands of wetlands From a point due south of the 881 Building and extending to the C 2 Pond approximately 0 15 acres of wetland are contained within this portion of the South Interceptor Ditch The species are observed to be primarily cat tails (greater than 95% predominance) spike rush (Eleocharis macrostachya) and bull rush (Scirpus americanus) The wetlands function primarily as flow attenuation with additional minor contribution in wildlife habitat and water quality enhancement

2 2 7 Historic Sites

The 903 Pad Mound and East Trenches Areas have been highly disturbed over a number of years Due to this disturbance and the topographic position of the program area the State Office of Archeology and Historic Preservation has determined that this action will not impact cultural resources (Burney 1989)

An archaeological and historical survey of the RFP was conducted between July 18 and August 22 1988 which determined two sites have potential eligibility to the National Register of Historic Places However insufficient information currently exists to make this determination These two sites are located northwest and southwest of the investigation area and will not be disturbed by the proposed action (Burney 1989)

2 3 CONTAMINANTS DESCRIPTION AND SOURCES

2 3 1 Ground Water Contamination

Organic contamination of alluvial and bedrock ground water at Operable Unit 2 is evident although the existence of elevated inorganic contamination in either alluvial or bedrock ground water is uncertain at this time due to the limited data on background chemical conditions for alluvial and bedrock ground water Water quality data from wells 55 86 (alluvial) and 54 86 (bedrock) located southwest of the plant and upgradient of all known SWMUs are the only current data available for characterizing background ground water chemistry Although more than two years of quarterly data exist for these wells the data is considered insufficient for background characterization for the following reasons

1) the data do not account for spatial variability
2) the alluvial ground water data may not be representative of colluvial ground water chemistry and
3) the bedrock ground water under investigation occurs in a different formation than that of the background wells

Nevertheless these data have been used to preliminarily determine which constituents in ground water at Operable Unit 2 are contaminants Constituent concentrations in ground water at Operable Unit 2 that exceed the upper limit of the range of concentrations in either well 55 86 (alluvial) or 54 86 (bedrock) are presumed to represent contaminants

A background characterization study is currently underway to provide more definitive information of the spatial and temporal variability of alluvial colluvial valley fill and bedrock ground water quality This data will be used to better evaluate the nature and extent of inorganic contamination at Operable Unit 2 and remedial action alternatives that address this contamination for the final RI/FS report For this interim action clean up criteria are defined by applicable or relevant and appropriate requirements (ARARs) as discussed in Section 3 0 Variances from ARARs may be appropriate in the future when background chemical conditions are adequately characterized

Tables 2 1 through 2 6 present data on well locations water elevations and well construction for alluvial and bedrock wells located in the vicinity of Operable Unit 2 The nature of contamination for each of the sites in Operable Unit 2 are summarized in Tables 2 7 through 2 12 Well locations are identified on Figure 2 5 The VOC maximum minimum and average concentrations reported in these tables are based on data from the first and

TABLE 2-1
903 PAD ALLUVIAL WELLS
LOCATION AND WELL DATA

WELL NUMBER	STATE NORTH COORDINATE	STATE EAST COORDINATE	R FLATS NORTH COORDINATE	R FLATS EAST COORDINATE	TOTAL DEPTH (FT)	ELEVATION TOP BEDROCK (FEET)	SCREENED INTERVAL (FT)		WATER DEPTH BELOW TOC (FEET)	DATE MEASURED	WATER LEVEL (FT)	SATURATED THICKNESS (FEET)
1587	749010 3218	2086248 6590	36020 14	23139 88	22 53	5948 89	5948 83	5965 09	20 03	09/12/89	5952 96	4 13
2987	748088 9555	2087361 3703	35094 87	24249 82	20 50	5792 62	5792 12	5808 92	14 05	09/15/89	5800 35	8 23
4487	748305 6314	2085435 0051	35317 96	22323 69	3 70	5946 33	5946 03	5948 03	DRY	10/26/89	DRY	DRY
6286	748156 0499	2085717 0180	35154 34	22613 19	35 19	5875 54	5862 35	5872 32	27 34	10/19/89	5871 41	9 06
6386	748144 5996	2085753 2740	35155 84	22641 51	15 50	5881 75	5885 15	5896 60	DRY	10/18/89	DRY	DRY
6486	747685 5186	2085601 1100	34683 82	22497 26	9 00	5825 68	5825 48	5831 07	DRY	10/16/89	DRY	DRY
6586	747888 4362	2087493 3790	34886 65	24389 54	8 00	5775 65	5774 75	5780 25	7 02	10/25/89	5777 38	2 63

TOC T p f C i g

TABLE 2-2
903 PAD BEDROCK WELLS
LOCATION AND WELL DATA

WELL NUMBER	STATE NORTH COORDINATE	STATE EAST COORDINATE	R FLATS NORTH COORDINATE	R FLATS EAST COORDINATE	TOTAL DEPTH (FT)	ELEVATION TOP BEDROCK (FEET)	SCREENED INTERVAL (FT)		WATER DEPTH BELOW TOC (FEET)	DATE MEASURED	WATER LEVEL (FT)	SATURATED THICKNESS (FEET)
0171	0 0000	0 0000	35823 90	23205 50	30 05	0 00	5920 83	5950 00	17 20	12/15/88	5933 63	12 80
0271	0 0000	0 0000	35528 12	22831 33	29 23	0 00	5907 56	5936 20	25 40	12/15/88	5911 39	3 83
0987	749068 0299	2085348 1453	36080 84	22239 33	32 40	5967 52	5948 07	5965 72	20 60	12/15/88	5961 12	13 05
1187	748409 2366	2086100 0436	35419 39	22989 24	20 50	5908 37	5893 32	5898 37	19 60	09/13/89	5895 76	2 44
1287	748580 6049	2086066 4205	35590 92	22956 17	10 25	5930 74	5924 74	5929 82	8 62	11/14/89	5927 87	3 13
1487	748228 2626	2086615 9564	35236 67	23504 68	24 30	5849 80	5830 95	5836 00	15 30	09/15/89	5841 43	10 48
1687	749129 7454	2086248 8779	36139 59	23140 49	125 2	5947 16	5844 06	5869 06	78 50	11/06/89	5892 48	48 42
3087	748089 4398	2087423 9554	35095 15	24312 43	94 35	5795 87	5717 52	5726 08	27 50	09/15/89	5786 30	68 78

TOC T p f C i g

TABLE 2-3
MOUND AREA ALLUVIAL WELLS
LOCATION AND WELL DATA

WELL NUMBER	STATE NORTH COORDINATE	STATE EAST COORDINATE	R FLATS NORTH COORDINATE	R FLATS EAST COORDINATE	TOTAL DEPTH (FT)	ELEVATION TOP BEDROCK (FEET)	SCREENED INTERVAL (FT)		WATER DEPTH BELOW TOC (FEET)	DATE MEASURED	WATER LEVEL (FT)	SATURATED THICKNESS (FEET)
1787	749415 1940	2086308 1281	36424 92	23200 70	25 75	5942 56	5945 56	5964 06	20 21	11/01/89	5949 32	3 76
1987	749623 1990	2086171 6264	36633 42	23064 85	11 89	5956 58	5956 33	5964 48	DRY	09/12/89	DRY	DRY
2187	749968 6664	2085799 5648	36980 21	22693 84	10 56	5917 18	5917 18	5924 35	7 05	11/10/89	5922 31	5 13
2487	749750 6926	2086746 2613	36759 05	23640 05	13 85	5944 39	5944 19	5954 29	DRY	11/01/89	DRY	DRY
3386	749962 6590	2085000 2370	36960 93	21896 47	7 34	5942 28	5941 94	5946 29	DRY	11/16/89	DRY	DRY
3586	750178 7010	2086218 1420	37176 97	23114 38	11 60	5898 90	5897 60	5904 34	9 03	09/12/89	5902 51	4 91
3686	750397 1536	2086819 1070	37395 41	23715 31	6 50	5876 44	5875 45	5878 44	DRY	11/10/89	DRY	DRY
4386	749416 7604	2085865 4760	36415 05	22761 70	16 75	5953 89	5953 64	5966 40	17 83	09/12/89	5954 66	1 02

TOC T p f C i g

TABLE 2-4
MOUND AREA BEDROCK WELLS
LOCATION AND WELL DATA

WELL NUMBER	STATE NORTH COORDINATE	STATE EAST COORDINATE	R FLATS NORTH COORDINATE	R FLATS EAST COORDINATE	TOTAL DEPTH (FT)	ELEVATION TOP BEDROCK (FEET)	SCREENED INTERVAL (FT)		WATER DEPTH BELOW TOC (FEET)	DATE MEASURED	WATER LEVEL (FT)	SATURATED THICKNESS (FEET)
0174	0 0000	0 0000	36643 80	23069 00	24 96	0 00	5943 84	5968 00	17 50	11/17/89	5951 30	7 46
1887	749404 1222	2086338 6941	36413 74	23231 24	133 7	5942 78	5833 93	5840 38	122 15	11/02/89	5847 30	13 37
2087	749634 1973	2086155 1645	36644 48	23048 42	116 4	5956 30	5851 99	5860 84	108 73	09/12/89	5861 37	9 38
2287	749923 5377	2085821 5930	36934 99	22715 72	88 70	5917 90	5842 24	5849 29	80 45	11/10/89	5852 04	9 80
2387	749404 1201	2085910 3415	36415 15	22802 78	37 85	5957 09	5934 73	5955 15	17 29	09/12/89	5957 20	22 47
2587	749718 7298	2086747 6965	36727 08	23641 38	43 70	5942 41	5915 46	5941 41	25 01	11/02/89	5935 95	20 49
3486	750173 1389	2086192 1520	37171 41	23088 39	56 25	5894 34	5854 19	5866 20	21 65	09/12/89	5891 13	36 94

TOC T p f C i g

TABLE 2-5
EAST TRENCHES ALLUVIAL WELLS
LOCATION AND WELL DATA

WELL NUMBER	STATE NORTH COORDINATE	STATE EAST COORDINATE	R FLATS NORTH COORDINATE	R FLATS EAST COORDINATE	TOTAL DEPTH (FT)	ELEVATION TOP BEDROCK (FEET)	SCREENED INTERVAL (FT)		WATER DEPTH BELOW TOC (FEET)	DATE MEASURED	WATER LEVEL (FT)	SATURATED THICKNESS (FEET)
2687	749255 6958	2087489 6385	36261 48	24381 98	13 70	5940 86	5940 61	5950 06	DRY	11/01/89	DRY	DRY
2787	749438 0421	2088051 5380	36442 01	24944 62	43 25	5904 77	5904 52	5944 02	85 42	10/30/89	5864 31	40 21
3287	749510 7405	2088362 8092	36513 70	25256 21	46 80	5899 82	5899 57	5910 12	35 96	09/12/89	5912 07	12 50
3387	749854 5591	2087920 7058	36859 07	24815 13	20 25	5925 52	5925 27	5930 27	28 88	09/12/89	5918 27	7 00
3587	749974 5030	2087267 9351	36981 20	24162 59	9 60	5940 26	5940 01	5945 86	DRY	11/17/89	DRY	DRY
3786	751563 0018	2088862 4820	38561 44	25758 47	8 55	5784 27	5783 47	5788 73	3 59	09/12/89	5790 56	7 09
3886	752825 8544	2090281 3730	39822 72	27177 53	8 50	5718 13	5719 63	5728 13	6 15	11/07/89	5724 53	4 90
3986	751290 6447	2090695 5130	38288 72	27591 82	31 50	5874 41	5873 41	5899 91	25 66	11/10/89	5880 95	7 54
4186	749613 2570	2088540 8520	36611 43	25437 08	44 70	5895 63	5895 33	5936 13	34 03	09/12/89	5907 80	12 47
4286	749567 5710	2087111 6510	36565 80	24007 88	29 70	5925 74	5924 64	5948 22	21 12	09/12/89	5935 31	10 67
6686	746640 6086	2091255 4530	33638 66	28151 55	6 50	5679 32	5678 62	5682 62	5 10	10/12/89	5681 63	3 01
6786	748710 4048	2090362 5100	35706 56	27253 77	14 75	5782 26	5781 51	5793 76	15 45	09/14/89	5782 28	0 77

TOC T p f C i g

TABLE 2-6
EAST TRENCHES BEDROCK WELLS
LOCATION AND WELL DATA

WELL NUMBER	STATE NORTH COORDINATE	STATE EAST COORDINATE	R FLATS NORTH COORDINATE	R FLATS EAST COORDINATE	TOTAL DEPTH (FT)	ELEVATION TOP BEDROCK (FEET)	SCREENED INTERVAL (FT)	WATER DEPTH BELOW TOC (FEET)	DATE MEASURED	WATER LEVEL (FT)	SATURATED THICKNESS (FEET)
0374	0 0000	0 0000	36944 90	23884 50	25 04	0 00	5926 22 5950 20	DRY	11/17/89	DRY	DRY
2887	749438 4716	2088090 3222	36442 31	24983 42	197 7	5903 67	5749 80 5759 80	187 41	09/12/89	5762 62	12 82
3187	749499 8322	2088308 5132	36502 97	25201 86	129 6	5900 02	5815 61 5834 36	96 13	09/12/89	5851 43	35 82
3487	749835 9078	2087931 3614	36840 38	24825 73	104 5	5925 21	5840 97 5847 92	67 73	09/12/89	5879 49	38 52
3687	749979 1830	2087295 1168	36985 79	24189 80	63 59	5941 54	5885 69 5929 24	34 92	11/10/89	5916 20	30 51
4086	749614 6648	2088501 8570	36612 84	25398 09	111 5	5896 23	5829 73 5853 25	93 03	09/12/89	5849 18	19 45

TOC T p f C i g

TABLE 2-7
VOLATILE ORGANIC COMPOUND CONCENTRATIONS ABOVE ESTIMATED BACKGROUND FOR 903-PAD ALLUVIAL WELLS
ALL CONCENTRATIONS IN ug/l

Reported when the maximum value exceeds Background

Analyte	Background Value		ARAR Value		Maximum Value		Minimum Value		Average of All Values	Wells/Stations in which Background Value was exceeded
Chloromethane	10	U								
Bromomethane	10	U								
Vinyl Chloride	10	U	2							
Chloroethane	10	U								
Methylene Chloride	5	U	5	U						
Acetone	10	U	50							
Carbon Disulfide	5	U	5	U						
1 1 Dichloroethene	5	U	7							
1 1 Dichloroethane	5	U	5	U						
1 2 Dichloroethene (total)	5	U								
Chloroform	5	U	100		21		5	U	6	1587
1 2 Dichloroethane	5	U	5							
2 Butanone	10	U								
1 1 1 Trichloroethane	5	U	200							
Carbon Tetrachloride	5	U	5		1100	J	1	J	222	1587
Vinyl Acetate	10	U								
Bromodichloromethane	5	U								
1 2 Dichloropropane	5	U								
cis 1 3 Dichloropropene	5	U								
Trichloroethene	5	U	5		120		5	U	26	1587
Dibromochloromethane	5	U								
1 1 2 Trichloroethane	5	U	5	U						
Benzene	5	U	5	U						
Trans 1 3 Dichloropropene	5	U								
Bromoform	5	U								
4 Methyl 2 pentanone	10	U								
2 Hexanone	10	U								
Tetrachloroethene	5	U	5	U	190 +		5	U	40	6486 1587
1 1 2 2 Tetrachloroethane	5	U								
Toluene	5	U	2000							
Chlorobenzene	5	U								
Ethylbenzene	5	U								
Styrene	5	U								
Total Xylenes	5	U								

No standard RCRA Appendix IX constituent therefore background value is TBC Value exceeds ARAR
The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit
NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank ______ Average exceeds background
Notes Minimum Maximum and Average based on 1989 first and second quarter data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 4487 6386 6486 1587 2987 6586 6286

TABLE 2-7 (Continued)
DISSOLVED METAL CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR 903-PAD ALLUVIAL WELLS
ALL CONCENTRATIONS IN mg/l

Reported when the maximum value exceeds Background

Analyte	Detec Limit	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Aluminum (Al)	0 0290	0 223	5 0	0 2410	0 0290 U	0 0486	6586
Antimony (Sb)	0 0600	0 06 U	0 06 U	0 1177 +	0 019	0 0383	2987
Arsenic (As)	0 0100	0 01 U	0 05				
Barium (Ba)	0 0100	0 071	1 0	0 2399	0 0191	0 0931	6486 1587 6586
Beryllium (Be)	0 0050	0 005 U	0 1				
Cadmium (Cd)	0 0050	0 005 U	0 01				
Calcium (Ca)	0 7500	33 8	NS	355 12	27 766	122	6486 1587 2987 6586 6286
Cesium (Cs)	0 0200	0 02 U	NS				
Chromium (Cr)	0 0100	0 026	0 05	0 0453	0 0100 U	0 0114	1587 2987 6286
Copper (Cu)	0 0063	0 046	0 2	0 8355	0 0063 U	0 0484	2987
Iron (Fe)	0 0069	0 162	0 3	0 4065 +	0 0069 U	0 0373	6586
Lead (Pb)	0 0050	0 016	0 05	0 024	0 001 J	0 0037	6586 6286
Lithium (Li)	0 1000	0 1 U	2 5	0 16	0 01 J	0 0647	2987
Magnesium (Mg)	0 0500	5 9	NS	135 71	4 1261	35	6486 1587 2987 6586 6286
Manganese (Mn)	0 0051	0 066	0 05	0 4425 +	0 0051 U	0 1097 +	6486 1587 2987 6586
Mercury (Hg)	0 0002	0 0002U	0 002	0 006 +	0 0001 J	0 0004	6486 6286
Molybdenum(Mo)	0 0220	0 022 U	0 1	0 0808	0 0220 U	0 0176	6486 2987
Nickel (Ni)	0 0370	0 037 U	0 20	1 4097	0 0370 U	0 2064	6486 2987 6586 6286
Potassium (K)	0 5000	0 8	NS	13 0	0 7	3 0904	6486 1587 2987 6586 6286
Selenium (Se)	0 0050	0 005 U	0 01	0 37 +	0 002 J	0 0549	6486 2987 6286
Silver (Ag)	0 0076	0 083	0 05				
Sodium (Na)	2 1000	13 1	NS	405 01	7 6207	124	6486 2987 6586 6286
Strontium (Sr)	0 0200	0 15	NS	4 9549	0 3812	1 2177	6486 1587 2987 6586 6286
Thallium (Tl)	0 0100	0 01 U	0 01 U				
Vanadium (V)	0 0240	0 024	0 1	0 0368	0 0240 U	0 0132	6486
Zinc (Zn)	0 0200	0 164	2 0	2 7735 +	0 02	0 1977	2987

Value exceeds ARAR ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 4487 6386 6486 1587 2987 6586 6286

TABLE 2-7 (Continued)
INORGANIC CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR 903-PAD ALLUVIAL WELLS
ALL CONCENTRATIONS IN MG/L

Reported when the maximum value exceeds Background

Analyte	Background Value	ARAR/TBC Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Total Dissolved Solids	167	400	3219	274	914	6486 1587 2987 6586 6286
Chloride	19	250	819 +	25 5	163	6486 1587 2987 6586 6286
Nitrate Nitrite as N	1 5	10	9 1	0 02 U	2 155	1587 6286
Sulfate	27	250	1157	15 5	271	6486 1587 2987 6586 6286
HCO3 as CaCO3	79	NS	306	67 5	211	6486 1587 2987 6586 6286

\+ Value exceeds ARAR ______ Average exceeds background

* The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 4487 6386 6486 1587 2987 6586 6286

TABLE 2-7 (Continued)
DISSOLVED RADIOCHEMISTRY CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR 903-PAD ALLUVIAL WELLS
ALL CONCENTRATIONS IN pCi/l

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Gross Alpha	5	15	46 +	< 2 00	12	6486 1587 2987 6586 6286
Gross Beta	14	50	33	< 4 00	6 3	2987 6286
Strontium 89 90	1 0 *	8	2 0	< 1 00	1 3	6586
Plutonium 239 240	01	15	0 522	< 0 01	0 026	1587
Americium 241	01	4	0 831	0 01	0 038	1587
Tritium	400	20000				
Total Uranium	1 8	40	26 0	1 80	7 5	6486 1587 2987 6586 6286

\+ Value exceeds ARAR/ ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates a less than (<) value or the counting error for a datum is greater than the datum the value used in the computation is one half the minimum detectable activity (MDA)

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank MDA Minimum Detectable Activity

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 4487 6386 6486 1587 2987 6586 6286

TABLE 2-8
VOLATILE ORGANIC COMPOUND CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR 903-PAD BEDROCK WELLS
ALL CONCENTRATIONS IN ug/l

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Chloromethane	10 U					
Bromomethane	10 U					
Vinyl Chloride	10 U	2				
Chloroethane	10 U					
Methylene Chloride	5 U	5 U				
Acetone	10 U	50				
Carbon Disulfide	5 U	5 U				
1 1 Dichloroethene	5 U	7				
1 1 Dichloroethane	5 U	5 U	11	5 U	3	0271
1 2 Dichloroethene (total)	5 U					
Chloroform	5 U	100	330	2	<u>36</u>	1487 0171 0271
1 2 Dichloroethane	5 U	5				
2 Butanone	10 U					
1 1 1 Trichloroethane	5 U	200				
Carbon Tetrachloride	5 U	5	690 J	1 J	<u>100</u>	1487 0171
Vinyl Acetate	10 U					
Bromodichloromethane	5 U					
1 2 Dichloropropane	5 U					
cis 1 3 Dichloropropene	5 U					
Trichloroethene	5 U	5	1200 +	5 U	<u>144</u>	1487 0171 0271
D b omochloromethane	5 U					
1 1 2 Trichloroethane	5 U	5 U				
Benzene	5 U	5 U				
Trans 1 3 Dichloropropene	5 U					
Bromoform	5 U					
4 Methyl 2 pentanone	10 U					
2 Hexanone	10 U					
Tetrachloroethene	5 U	5 U	78	4 J	<u>13</u>	0171 0271
1 1 2 2 Tetrachloroethane	5 U					
Toluene	5 U	2000				
Chlorobenzene	5 U					
Ethylbenzene	5 U					
Styrene	5 U					
Total Xylenes	5 U					

No standard RCRA Appendix IX constituent therefore background value is TBC   Value exceeds ARAR
The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit
NS No Standard   U Detection Limit   J Present below Detection Limit   B Present in Blank   ______ Average exceeds background
Notes Minimum Maximum and Average based on 1989 first and second quarter data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 0987 4587 6286 1687 1487 3087 1287 1187 0171 0271

TABLE 2-8 (Continued)
DISSOLVED METAL CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR 903-PAD BEDROCK WELLS
ALL CONCENTRATIONS IN mg/l

Reported when the maximum value exceeds Background

Analyte	Detec Limit	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Aluminum (Al)	0 0290	0 223	5 0	1 1972	0 0290 U	0 0725	1487
Antimony (Sb)	0 0600	0 06 U	0 06 U	0 0710 +	0 02 U	0 0305	0271
Arsenic (As)	0 0100	0 01 U	0 05	0 040	0 002 J	0 0053	3087
Barium (Ba)	0 0100	0 071	1 0	0 9321	0 0191	0 1090	0987 4587 1687 1487 3087 1287 1187 0171 0271
Beryllium (Be)	0 0050	0 005 U	0 1				
Cadmium (Cd)	0 0050	0 005 U	0 01	0 0058	0 0003 J	0 0024	4587
Calcium (Ca)	0 7500	33 8	NS	408 44	6 0019	60	0987 4587 6286 1487 1287 1187 0171 0271
Cesium (Cs)	0 0200	0 02 U	NS				
Chromium (Cr)	0 0100	0 026	0 05	0 0561 +	0 0100 U	0 0115	6286 1687 1487 1287 0271
Copper (Cu)	0 0063	0 046	0 2				
Iron (Fe)	0 0069	0 162	0 3	1 2330	0 0069 U	0 1109	1287 0171 0271
Lead (Pb)	0 0050	0 016	0 05	0 021	0 002 J	0 0032	6286 0171 0271
Lithium (Li)	0 1000	0 1 U	2 5	0 13	0 01 J	0 0561	1287
Magnesium (Mg)	0 0500	5 9	NS	45 864	0 0295	11	0987 4587 6286 1487 1287 1187 0171 0271
Manganese (Mn)	0 0051	0 066	0 05	0 4031 +	0 0051 U	0 0863	4587 1287 1187 0171 0271
Mercury (Hg)	0 0002	0 0002U	0 002	0 0017	0 0001 J	0 0001	6286 0271
Molybdenum(Mo)	0 0220	0 022 U	0 1	0 0650	0 0220 U	0 0158	4587 1687 3087
Nickel (Ni)	0 0370	0 037 U	0 20	0 2561 +	0 0370 U	0 0402	4587 6286 3087 1287 1187 0171 0271
Potassium (K)	0 5000	0 8	NS	31	0 7	5 9712	0987 4587 6286 1687 1487 3087 1287 1187 0171
Selenium (Se)	0 0050	0 005 U	0 01	0 071 +	0 002 J	0 0119 +	6286 1487 1187 0271
Silver (Ag)	0 0076	0 083	0 05				
Sodium (Na)	2 1000	13 1	NS	259 55	6 9667	87	4587 6286 1687 1487 3087 1287 1187 0171 0271
Strontium (Sr)	0 0200	0 15	NS	7 7076	0 2057	0 6010	0987 4587 6286 1687 1487 3087 1287 1187 0171
Thallium (Tl)	0 0100	0 01 U	0 01 U				
Vanadium (V)	0 0240	0 024	0 1	0 0915	0 0160 U	0 0153	1687 1487 3087 0171
Zinc (Zn)	0 0200	0 164	2 0				

\+ Value exceeds ARAR ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 0987 4587 6286 1687 1487 3087 1287 1187 0171 0271

TABLE 2-8 (Continued)
INORGANIC CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR 903-PAD BEDROCK WELLS
ALL CONCENTRATIONS IN MG/L

Reported when the maximum value exceeds Background

Analyte	Background Value	ARAR/TBC Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Total Dissolved Solids	167	400	1627 J	118	458	0987 4587 6286 1687 1487 3087 1287 1187 0171 0271
Chloride	19	250	573 J +	3 33 J	69	6286 1487 3087 1287 1187 0171 0271
Nitrate Nitrite as N	1 5	10	7 41	0 02 U	1 993	0987 6286 1687 1487 1287 1187 0171 0271
Sulfate	27	250	328 +	1 83	71	0987 4587 6286 1687 1487 1287 1187 0271
HCO3 as CaCO3	79	NS	530	23 1	184	0987 4587 6286 1687 1487 3087 1287 1187 0171 0271

Value exceeds ARAR ______ Average exceeds background
The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit
NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank
Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 0987 4587 6286 1687 1487 3087 1287 1187 0171 0271

TABLE 2-8 (Continued)
DISSOLVED RADIOCHEMISTRY CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR 903-PAD BEDROCK WELLS
ALL CONCENTRATIONS IN pCi/l

Reported when the maximum value exceeds Background

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Gross Alpha	5	15	121 +	< 2 00	16	4587 6286 1687 1487 3087 1287 1187 0171 0271
Gross Beta	14	50	113	< 4 00	14	4587 6286 1687 1487 1287 0271
Strontium 89 90	1 0	8	2 6	< 1 00	0 71	0171
Plutonium 239 240	01	15	0 199	0 01	0 015	1187
Americium 241	01	4	17	0 01	0 011	3087 1187
Tritium	400	20000	510	400 00	218	0987
Total Uranium	1 8	40	62 0	< 1 80	9 2	4587 6286 1687 1487 1287 1187 0171 0271

\+ Value exceeds ARAR/ ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates a less than (<) value or the counting error for a datum is greater than the datum the value used in the computation is one half the minimum detectable activity (MDA)

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank MDA Minimum Detectable Activity

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 0987 4587 6286 1687 1487 3087 1287 1187 0171 0271

TABLE 2-9
VOLATILE ORGANIC COMPOUND CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR MOUND-AREA ALLUVIAL WELLS
ALL CONCENTRATIONS IN ug/1

Analyte	Background Value		ARAR Value		Maximum Value	Minimum Value		Average of All Values	Wells/Stations in which Background Value was exceeded
					Reported when the maximum value exceeds Background				
Chloromethane	10	U							
Bromomethane	10	U							
Vinyl Chloride	10	U	2		520 +	10	U +	171 +	3586
Chloroethane	10	U							
Methylene Chloride	5	U	5	U					
Acetone	10	U	50						
Carbon Disulfide	5	U	5	U					
1 1 Dichloroethene	5	U	7		13	5	U	4	3586
1 1 Dichloroethane	5	U	5	U	59	5	U	17	3586
1 2 Dichloroethene (total)	5	U							
Chloroform	5	U	100						
1 2 Dichloroethane	5	U	5						
2 Butanone	10	U							
1 1 1 Trichloroethane	5	U	200						
Carbon Tetrachloride	5	U	5		71	5	U	21	1787
Vinyl Acetate	10	U							
Bromodichloromethane	5	U							
1 2 Dichloropropane	5	U							
cis 1 3 Dichloropropene	5	U							
Trichloroethene	5	U	5		21	5	U	9	1787 3586
Dibromochloromethane	5	U							
1 1 2 Trichloroethane	5	U	5	U					
Benzene	5	U	5	U					
Trans 1 3 Dichloropropene	5	U							
Bromoform	5	U							
4 Methyl 2 pentanone	10	U							
2 Hexanone	10	U							
Tetrachloroethene	5	U	5	U	160 +	5	U	52	1787
1 1 2 2 Tetrachloroethane	5	U							
Toluene	5	U	2000						
Chlorobenzene	5	U							
Ethylbenzene	5	U							
Styrene	5	U							
Total Xylenes	5	U							

No standard RCRA Appendix IX constituent therefore background value is TBC + Value exceeds ARAR
The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit
NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank ______ Average exceeds background
Notes Minimum Maximum and Average based on 1989 first and second quarter data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 2187 1787 3586 4386 1987 3386 3686 2487

TABLE 2-9 (Continued)
DISSOLVED METAL CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR MOUND-AREA ALLUVIAL WELLS
ALL CONCENTRATIONS IN mg/l

Reported when the maximum value exceeds Background

Analyte	Detec Limit	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Aluminum (Al)	0 0290	0 223	5 0				
Antimony (Sb)	0 0600	0 06 U	0 06 U				
Arsenic (As)	0 0100	0 01 U	0 05				
Barium (Ba)	0 0100	0 071	1 0	0 1602	0 0461	0 1124	1787 3586 4386
Beryllium (Be)	0 0050	0 005 U	0 1				
Cadmium (Cd)	0 0050	0 005 U	0 01				
Calcium (Ca)	0 7500	33 8	NS	146 41	68 029	108	1787 3586 4386
Cesium (Cs)	0 0200	0 02 U	NS				
Chromium (Cr)	0 0100	0 026	0 05	0 0266	0 0100 U	0 0063	3586
Copper (Cu)	0 0063	0 046	0 2	0 4235 +	0 0063 U	0 0660	1787
Iron (Fe)	0 0069	0 162	0 3	0 8573 +	0 0069 U	0 1420	3586
Lead (Pb)	0 0050	0 016	0 05				
Lithium (Li)	0 1000	0 1 U	2 5				
Magnesium (Mg)	0 0500	5 9	NS	33 154	6 7585	17	1787 3586 4386
Manganese (Mn)	0 0051	0 066	0 05	4 2350 +	0 0051 U	1 2880	1787 3586
Mercury (Hg)	0 0002	0 0002U	0 002				
Molybdenum(Mo)	0 0220	0 022 U	0 1	0 0238	0 0220 U	0 0124	4386
Nickel (Ni)	0 0370	0 037 U	0 20	0 6874 +	0 0370 U	0 1371	1787 3586
Potassium (K)	0 5000	0 8	NS	7 0	0 5	2 0371	1787 3586 4386
Selenium (Se)	0 0050	0 005 U	0 01				
Silver (Ag)	0 0076	0 083	0 05				
Sodium (Na)	2 1000	13 1	NS	210 05	8 1258	76	1787 3586 4386
Strontium (Sr)	0 0200	0 15	NS	0 8984	0 3216	0 5692	1787 3586 4386
Thallium (Tl)	0 0100	0 01 U	0 01 U				
Vanadium (V)	0 0240	0 024	0 1	0 0241	0 0240 U	0 0125	3586
Zinc (Zn)	0 0200	0 164	2 0	2 5552 +	0 0200 U	0 3169	1787

Value exceeds ARAR ______ Average exceeds background
The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit
NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank
Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 2187 1787 3586 4386 1987 3386 3686 2487

TABLE 2-9 (Continued)
INORGANIC CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR MOUND-AREA ALLUVIAL WELLS
ALL CONCENTRATIONS IN MG/L

Reported when the maximum value exceeds Background

Analyte	Background Value	ARAR/TBC Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Total Dissolved Solids	167	400	1011	338	599	1787 3586 4386
Chloride	19	250	275 +	30 8	74	1787 3586 4386
Nitrate Nitrite as N	1 5	10	7 90	0 02 U	2 778	1787 4386
Sulfate	27	250	180	26 9	73	1787 3586 4386
HCO3 as CaCO3	79	NS	642	166	325	1787 3586 4386

\+ Value exceeds ARAR ______ Average exceeds background

* The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 2187 1787 3586 4386 1987 3386 3686 2487

TABLE 2-9 (Continued)
DISSOLVED RADIOCHEMISTRY CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR MOUND-AREA ALLUVIAL WELLS
ALL CONCENTRATIONS IN pCi/l

			Reported when the maximum value exceeds Background			
Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Gross Alpha	5	15	18 +	< 2 00	3 6	1787
Gross Beta	14	50				
Strontium 89 90	1 0	8	1 2	1 00	1 0	3586 4386
Plutonium 239 240	01	15				
Americium 241	01	4	0 11	0 01	0 012	3586
Tritium	400	20000				
Total Uranium	1 8	40	9 3	< 1 80	3 8	1787 3586 4386

\+ Value exceeds ARAR/ ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates a less than (<) value or the counting error for a datum is greater than the datum the value used in the computation is one half the minimum detectable activity (MDA)

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank *MDA Minimum Detectable Activity

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 2187 1787 3586 4386 1987 3386 3686 2487

TABLE 2-10
VOLATILE ORGANIC COMPOUND CONCENTRATIONS ABOVE ESTIMATED BACKGROUND FOR MOUND-AREA BEDROCK WELLS
ALL CONCENTRATIONS IN ug/l

Reported when the maximum value exceeds Background

Analyte	Background Value		ARAR Value		Maximum Value	Minimum Value		Average of All Values	Wells/Stations in which Background Value was exceeded
Chloromethane	10	U							
Bromomethane	10	U							
Vinyl Chloride	10	U	2						
Chloroethane	10	U							
Methylene Chloride	5	U	5	U					
Acetone	10	U	50						
Carbon Disulfide	5	U	5	U					
1 1 Dichloroethene	5	U	7						
1 1 Dichloroethane	5	U	5	U					
1 2 Dichloroethene (total)	5	U							
Chloroform	5	U	100						
1 2 Dichloroethane	5	U	5						
2 Butanone	10	U							
1 1 1 Trichloroethane	5	U	200						
Carbon Tetrachloride	5	U	5		290	5	U	<u>36</u>	2587
Vinyl Acetate	10	U							
Bromodichloromethane	5	U							
1 2 Dichloropropane	5	U							
cis 1 3 Dichloropropene	5	U							
Trichloroethene	5	U	5		1800 +	5	U	<u>275</u>	2587 0174
Dibromochloromethane	5	U							
1 1 2 Trichloroethane	5	U	5	U					
Benzene	5	U	5	U					
Trans 1 3 Dichloropropene	5	U							
Bromoform	5	U							
4 Methyl 2 pentanone	10	U							
2 Hexanone	10	U							
Tetrachloroethene	5	U	5	U	45000 +	3	J	<u>5694</u> +	2387 1887 2087 2587 0174
1 1 2 2 Tetrachloroethane	5	U							
Toluene	5	U	2000						
Chlorobenzene	5	U							
Ethylbenzene	5	U							
Styrene	5	U							
Total Xylenes	5	U							

No standard RCRA Appendix IX constituent therefore background value is TBC + Value exceeds ARAR
The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit
NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank ______ Average exceeds background
Notes Minimum Maximum and Average based on 1989 first and second quarter data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 2387 2287 1887 2087 3486 2587 0174

TABLE 2-10 (Continued)
DISSOLVED METAL CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR MOUND-AREA BEDROCK WELLS
ALL CONCENTRATIONS IN mg/l

Reported when the maximum value exceeds Background

Analyte	Detec Limit	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Aluminum (Al)	0 0290	0 223	5 0	2 6796	0 0290 U	0 1333	2087 2587
Antimony (Sb)	0 0600	0 06 U	0 06 U	0 1059 +	0 02 U	0 0320	3486
Arsenic (As)	0 0100	0 01 U	0 05				
Barium (Ba)	0 0100	0 071	1 0	0 1949	0 0234	0 0982	2387 1887 3486 2587 0174
Beryllium (Be)	0 0050	0 005 U	0 1				
Cadmium (Cd)	0 0050	0 005 U	0 01				
Calcium (Ca)	0 7500	33 8	NS	242 31	12 326	87	2387 2287 3486 2587 0174
Cesium (Cs)	0 0200	0 02 U	NS				
Chromium (Cr)	0 0100	0 026	0 05	0 0785	0 0100 U	0 0099	2387 2587
Copper (Cu)	0 0063	0 046	0 2				
Iron (Fe)	0 0069	0 162	0 3	4 3470 +	0 0069 U	0 2860	2387 3486 2587
Lead (Pb)	0 0050	0 016	0 05				
Lithium (Li)	0 1000	0 1 U	2 5	0 2	0 01 J	0 0540	3486
Magnesium (Mg)	0 0500	5 9	NS	92 199	0 0342	16	2387 2287 3486 2587 0174
Manganese (Mn)	0 0051	0 066	0 05	0 7061	0 0051 U	0 0762	2387 1887 3486 2587
Mercury (Hg)	0 0002	0 0002U	0 002				
Molybdenum(Mo)	0 0220	0 022 U	0 1	0 0843	0 0220 U	0 0296	2287 1887 2087 3486 2587
Nickel (Ni)	0 0370	0 037 U	0 20	0 0661	0 0370 U	0 0269	2387 2287 1887
Potassium (K)	0 5000	0 8	NS	28	0 5	7 6163	2387 2287 2087 3486 2587 0174
Selenium (Se)	0 0050	0 005 U	0 01				
Silver (Ag)	0 0076	0 083	0 05				
Sodium (Na)	2 1000	13 1	NS	232 10	7 6229	66	2287 1887 2087 3486 2587 0174
Strontium (Sr)	0 0200	0 15	NS	3 1113	0 1107	0 7250	2387 2287 2087 3486 2587 0174
Thallium (Tl)	0 0100	0 01 U	0 01 U				
Vanadium (V)	0 0240	0 024	0 1	0 245 +	0 0240 U	0 0208	2387 2287 2087 3486 2587
Zinc (Zn)	0 0200	0 164	2 0				

Value exceeds ARAR ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 2387 2287 1887 2087 3486 2587 0174

TABLE 2-10 (Continued)
INORGANIC CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR MOUND-AREA BEDROCK WELLS
ALL CONCENTRATIONS IN MG/L

Reported when the maximum value exceeds Background

Analyte	Background Value	ARAR/TBC Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Total Dissolved Solids	167	400	1813	163	585	2387 2287 2087 3486 2587 0174
Chloride	19	250	65 9	5 70	28	2387 3486 2587 0174
Nitrate Nitrite as N	1 5	10	9 80	0 02 U	2 580	2387 2587 0174
Sulfate	27	250	1084 +	3 29 J	209	2387 2287 1887 2087 3486 2587 0174
HCO3 as CaCO3	79	NS	372	31 0	162	2387 2287 3486 2587 0174

Value exceeds ARAR _____ Average exceeds background

* The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 2387 2287 1887 2087 3486 2587 0174

TABLE 2-10 (Continued)
DISSOLVED RADIOCHEMISTRY CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR MOUND-AREA BEDROCK WELLS
ALL CONCENTRATIONS IN pCi/l

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Gross Alpha	5	15	39 +	2 00	5 3	2387 2287 2587 0174
Gross Beta	14	50	37	< 4 00	11	1887 2087
Strontium 89 90	1 0	8	5 0	< 1 00	1 8	3486 0174
Plutonium 239 240	01	15	0 07	0 01	0 0073	2387
Americium 241	01 *	4	0 065	< 0 01	0 0067	2587
Tritium	400	20000				
Total Uranium	1 8	40	11 0	1 80	2 8	2387 2287 3486 2587 0174

\+ Value exceeds ARAR/ ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates a less than (<) value or the counting error for a datum is greater than the datum the value used in the computation is one half the minimum detectable activity (MDA)

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank MDA Minimum Detectable Activity

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 2387 2287 1887 2087 3486 2587 0174

TABLE 2-11
VOLATILE ORGANIC COMPOUND CONCENTRATIONS ABOVE ESTIMATED BACKGROUND FOR EAST TRENCHES ALLUVIAL WELLS ALL CONCENTRATIONS IN ug/l

Reported when the maximum value exceeds Background

Analyte	Background Value		ARAR Value		Maximum Value		Minimum Value		Average of All Values	Wells/Stations in which Background Value was exceeded
Chloromethane	10	U								
Bromomethane	10	U								
Vinyl Chloride	10	U	2							
Chloroethane	10	U								
Methylene Chloride	5	U	5	U						
Acetone	10	U	50							
Carbon Disulfide	5	U	5	U						
1 1 Dichloroethene	5	U	7							
1 1 Dichloroethane	5	U	5	U						
1 2 Dichloroethene (total)	5	U								
Chloroform	5	U	100		21	J	3	J	5	4286
1 2 Dichloroethane	5	U	5							
2 Butanone	10	U								
1 1 1 Trichloroethane	5	U	200							
Carbon Tetrachloride	5	U	5		1100 +		5	U	137	4286 2787
Vinyl Acetate	10	U								
Bromodichloromethane	5	U								
1 2 Dichloropropane	5	U								
cis 1 3 Dichloropropene	5	U								
Trichloroethene	5	U	5		190		3	J	23	4286
Dibromochloromethane	5	U								
1 1 2 Trichloroethane	5	U	5	U						
Benzene	5	U	5	U						
Trans 1 3 Dichloropropene	5	U								
Bromoform	5	U								
4 Methyl 2 pentanone	10	U								
2 Hexanone	10	U								
Tetrachloroethene	5	U	5	U	300		3	J	43	4286 2787 3786
1 1 2 2 Tetrachloroethane	5	U								
Toluene	5	U	2000							
Chlorobenzene	5	U								
Ethylbenzene	5	U								
Styrene	5	U								
Total Xylenes	5	U								

No standard RCRA Appendix IX constituent therefore background value is TBC + Value exceeds ARAR

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank ______ Average exceeds background

Notes Minimum Maximum and Average based on 1989 first and second quarter data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 4286 2787 3287 4186 3986 6686 6786 2687 3786 3886 3587 3387

TABLE 2-11 (Continued)
DISSOLVED METAL CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR EAST TRENCHES ALLUVIAL WELLS
ALL CONCENTRATIONS IN mg/1

Reported when the maximum value exceeds Background

Analyte	Detec Limit	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Aluminum (Al)	0 0290	0 223	5 0	2 6303	0 0290 U	0 0832	4286
Antimony (Sb)	0 0600	0 06 U	0 06 U	0 1030	0 006 J	0 0307	3886
Arsenic (As)	0 0100	0 01 U	0 05				
Barium (Ba)	0 0100	0 071	1 0	0 3254	0 0461	0 1478	4286 2787 3287 4186 3986 6686 6786 3886
Beryllium (Be)	0 0050	0 005 U	0 1				
Cadmium (Cd)	0 0050	0 005 U	0 01				
Calcium (Ca)	0 7500	33 8	NS	391 07	24 184	120	4286 2787 3287 4186 3986 6686 6786 3886
Cesium (Cs)	0 0200	0 02 U	NS				
Chromium (Cr)	0 0100	0 026	0 05	0 0417	0 0100 U	0 0068	3287
Copper (Cu)	0 0063	0 046	0 2	0 2227	0 0063 U	0 0175	4286 3287 3886
Iron (Fe)	0 0069	0 162	0 3	2 1119 +	0 0069 U	0 0838	4286 4186
Lead (Pb)	0 0050	0 016	0 05	0 022	0 005 U	0 0040	6686 6786
Lithium (Li)	0 1000	0 1 U	2 5	0 15	0 01 J	0 0600	3886
Magnesium (Mg)	0 0500	5 9	NS	127 67	5 4617	25	4286 2787 3287 4186 3986 6686 6786 3886
Manganese (Mn)	0 0051	0 066	0 05	1 0614 +	0 0051 U	0 1331	4286 3287 4186 6686 3886
Mercury (Hg)	0 0002	0 0002U	0 002	0 013	0 0002 U	0 0004	4286 3986
Molybdenum(Mo)	0 0220	0 022 U	0 1				
Nickel (Ni)	0 0370	0 037 U	0 20	0 7804 +	0 0370 U	0 0879	4286 3287 4186 6686 3886
Potassium (K)	0 5000	0 8	NS	8 2	0 7	2 0707	4286 2787 3287 4186 3986 6686 3886
Selenium (Se)	0 0050	0 005 U	0 01	0 006	0 002 J	0 0026	3886
Silver (Ag)	0 0076	0 083	0 05	0 1280	0 0076 U	0 0070	4286
Sodium (Na)	2 1000	13 1	NS	289 22	14 449	54	4286 2787 3287 4186 3986 6686 6786 3886
Strontium (Sr)	0 0200	0 15	NS	4 5789	0 1450	0 8457	4286 2787 3287 4186 3986 6686 6786 3886
Thallium (Tl)	0 0100	0 01 U	0 01 U				
Vanadium (V)	0 0240	0 024	0 1	0 0393	0 0240 U	0 0143	4286 4186 3986 6786
Zinc (Zn)	0 0200	0 164	2 0	0 9800	0 0200 U	0 0529	3287

Value exceeds ARAR ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 4286 2787 3287 4186 3986 6686 6786 2687 3786 3886 3587 3387

TABLE 2-11 (Continued)
INORGANIC CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR EAST TRENCHES ALLUVIAL WELLS
ALL CONCENTRATIONS IN MG/L

Reported when the maximum value exceeds Background

Analyte	Background Value	ARAR/TBC Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded							
Total Dissolved Solids	167	400	2181 +	163	640	4286	2787	3287	4186	3986	6686	6786	3886
Chloride	19	250	947	10 9	70	4286	2787	3287	4186	3986	6686	6786	3886
Nitrate Nitrite as N	1 5	10	15 45	0 02	5 341	4286	2787	3287	4186	3986	6786		
Sulfate	27	250	820 +	16 5	139	4286	2787	3287	4186	3986	6686	6786	3886
HCO3 as CaCO3	79	NS	455	73 9	243	4286	2787	3287	4186	3986	6686	6786	3886

\+ Value exceeds ARAR ______ Average exceeds background
The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit
NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank
Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 4286 2787 3287 4186 3986 6686 6786 2687 3786 3886 3587 3387

TABLE 2-11 (Continued)
DISSOLVED RADIOCHEMISTRY CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR EAST TRENCHES ALLUVIAL WELLS
ALL CONCENTRATIONS IN pCi/l

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Gross Alpha	5	15	215 +	< 2 00	22 +	4286 2787 3287 4186 3986 6686 3886
Gross Beta	14	50	144 +	< 4 00	24	4286 3287 4186 3986 6786 3886
Strontium 89 90	1 0	8	1 4	< 1 00	1 0	4286 4186 3986 6786
Plutonium 239 240	01	15	0 18	0 01	0 0094	4286
Americium 241	01	4	0 10	0 01	0 011	3287
Tritium	400	20000	560	400 00	210	4286
Total Uranium	1 8	40	52 0 +	1 80	7 9	4286 2787 3287 4186 3986 6786 3886

\+ Value exceeds ARAR/ ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates a less than (<) value or the counting error for a datum is greater than the datum the value used in the computation is one half the minimum detectable activity (MDA)

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank MDA Minimum Detectable Activity

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 4286 2787 3287 4186 3986 6686 6786 2687 3786 3886 3587 3387

TABLE 2-12
VOLATILE ORGANIC COMPOUND CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR EAST TRENCHES BEDROCK WELLS
ALL CONCENTRATIONS IN ug/l

Reported when the maximum value exceeds Background

Analyte	Background Value		ARAR Value		Maximum Value	Minimum Value		Average of All Values	Wells/Stations in which Background Value was exceeded
Chloromethane	10	U							
Bromomethane	10	U							
Vinyl Chloride	10	U	2						
Chloroethane	10	U							
Methylene Chloride	5	U	5	U					
Acetone	10	U	50						
Carbon Disulfide	5	U	5	U					
1 1 Dichloroethene	5	U	7		32 +	5	U	7	3687
1 1 Dichloroethane	5	U	5	U					
1 2 Dichloroethene (total)	5	U							
Chloroform	5	U	100		290E +	5	U	50	3687 0374
1 2 Dichloroethane	5	U	5						
2 Butanone	10	U							
1 1 1 Trichloroethane	5	U	200		63	5	U	8	3687
Carbon Tetrachloride	5	U	5		1100	5	U	288	3687 0374
Vinyl Acetate	10	U							
Bromodichloromethane	5	U							
1 2 Dichloropropane	5	U							
cis 1 3 Dichloropropene	5	U							
Trichloroethene	5	U	5		49000 +	5	U	5091	3687 3487 4086 0374
Dibromochloromethane	5	U							
1 1 2 Trichloroethane	5	U	5	U					
Benzene	5	U	5	U					
Trans 1 3 Dichloropropene	5	U							
Bromoform	5	U							
4 Methyl 2 pentanone	10	U							
2 Hexanone	10	U							
Tetrachloroethene	5	U	5	U	350E +	5	U	61 +	3687 0374
1 1 2 2 Tetrachloroethane	5	U							
Toluene	5	U	2000						
Chlorobenzene	5	U							
Ethylbenzene	5	U							
Styrene	5	U							
Total Xylenes	5	U							

No standard RCRA Appendix IX constituent therefore background value is TBC + Value exceeds ARAR
The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit
NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank ______ Average exceeds background
Notes Minimum Maximum and Average based on 1989 first and second quarter data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 3687 3487 2887 3187 4086 0374

TABLE 2-12 (Continued)
DISSOLVED METAL CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR EAST TRENCHES BEDROCK WELLS
ALL CONCENTRATIONS IN mg/l

Reported when the maximum value exceeds Background

Analyte	Detec Limit	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Aluminum (Al)	0 0290	0 223	5 0	0 4668	0 0290 U	0 1045	2887 3187 4086 0374
Antimony (Sb)	0 0600	0 06 U	0 06 U				
Arsenic (As)	0 0100	0 01 U	0 05	0 019	0 004 J	0 0057	3187
Barium (Ba)	0 0100	0 071	1 0	0 2881	0 0146	0 0945	3687 2887 4086 0374
Beryllium (Be)	0 0050	0 005 U	0 1				
Cadmium (Cd)	0 0050	0 005 U	0 01				
Calcium (Ca)	0 7500	33 8	NS	192 58	12 652	70	3687 3487 4086 0374
Cesium (Cs)	0 0200	0 02 U	NS				
Chromium (Cr)	0 0100	0 026	0 05	0 1223 +	0 0100 U	0 0115	4086 0374
Copper (Cu)	0 0063	0 046	0 2	0 0463	0 0063 U	0 0111	2887
Iron (Fe)	0 0069	0 162	0 3	0 9745 +	0 0069 U	0 1268	3487 2887 3187 4086 0374
Lead (Pb)	0 0050	0 016	0 05				
Lithium (Li)	0 1000	0 1 U	2 5	0 22	0 01 J	0 0742	3487
Magnesium (Mg)	0 0500	5 9	NS	63 806	0 1157	11	3687 3487 4086 0374
Manganese (Mn)	0 0051	0 066	0 05	0 5351 +	0 0051 U	0 0682	3687 3487 4086
Mercury (Hg)	0 0002	0 0002U	0 002				
Molybdenum(Mo)	0 0220	0 022 U	0 1	0 1347	0 0220 U	0 0373	3487 2887 3187 4086
Nickel (Ni)	0 0370	0 037 U	0 20	0 0551	0 0370 U	0 0239	3687 4086 0374
Potassium (K)	0 5000	0 8	NS	14	0 7	3 8780	3687 3487 2887 3187 4086 0374
Selenium (Se)	0 0050	0 005 U	0 01				
Silver (Ag)	0 0076	0 083	0 05				
Sodium (Na)	2 1000	13 1	NS	219 15	8 8509	65	3487 2887 3187 4086 0374
Strontium (Sr)	0 0200	0 15	NS	2 5972	0 1373	0 5086	3687 3487 2887 3187 4086 0374
Thallium (Tl)	0 0100	0 01 U	0 01 U				
Vanadium (V)	0 0240	0 024	0 1	0 1137 +	0 0240 U	0 0227	2887 3187
Zinc (Zn)	0 0200	0 164	2 0	0 36	0 0200 U	0 0357	0374

\+ Value exceeds ARAR ______ Average exceeds background

* The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 3687 3487 2887 3187 4086 0374

TABLE 2-12 (Continued)
INORGANIC CONSTITUENT CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR EAST TRENCHES BEDROCK WELLS
ALL CONCENTRATIONS IN MG/L

Reported when the maximum value exceeds Background

Analyte	Background Value	ARAR/TBC Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
Total Dissolved Solids	167	400	1011	137	421	3687 3487 2887 3187 4086 0374
Chloride	19	250	218	3 94	29	3687 2887 3187 4086 0374
Nitrate Nitrite as N	1 5	10	9 60	0 02	2 657	3687 3187 4086 0374
Sulfate	27	250	470	19 8	109	3687 3487 2887 3187 4086 0374
HCO3 as CaCO3	79	NS	293	35 3	154	3687 3487 2887 3187 4086 0374

\+ Value exceeds ARAR ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates non detected the value used in the computation is one half the detection limit

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 3687 3487 2887 3187 4086 0374

TABLE 2-12 (Continued)
DISSOLVED RADIOCHEMISTRY CONCENTRATIONS
ABOVE ESTIMATED BACKGROUND FOR EAST TRENCHES BEDROCK WELLS
ALL CONCENTRATIONS IN pCi/l

Analyte	Background Value	ARAR Value	Maximum Value	Minimum Value	Average of All Values	Wells/Stations in which Background Value was exceeded
			Reported when the maximum value exceeds Background			
Gross Alpha	5	15	250	< 2 00	24 +	3687 3487 2887 3187 4086 0374
Gross Beta	14	50	327 +	4 00	29	3687 3487 4086 0374
Strontium 89 90	1 0	8				
Plutonium 239 240	01	15				
Americium 241	01	4	0 08	< 0 01	0 0092	3187
Tritium	400	20000				
Total Uranium	1 8	40	10 3	1 80	3 9	3687 3487 2887 4086 0374

Value exceeds ARAR/ ______ Average exceeds background

The average is computed by first determining the arithmetic mean concentration at individual wells/stations and then using this data to compute the arithmetic mean for the wells/stations in this group If a datum indicates a less than ( ) value or the counting error for a datum is greater than the datum the value used in the computation is one half the minimum detectable activity (MDA)

NS No Standard U Detection Limit J Present below Detection Limit B Present in Blank MDA Minimum Detectable Activity

Notes Minimum Maximum and Average based on 1987/1988 Quarterly Data
Background values based on upper limit of values found in well 55 86
Wells/Stations in this group 3687 3487 2887 3187 4086 0374

second quarter 1989 groundwater sampling as this is the only validated VOC data available to date that was categorized acceptable All other analytes reported in the tables use 1987 and 1988 quarterly data The grouping of alluvial ground water wells averaging of data and comparison to ARARs is only intended to provide the reader with an overview of the magnitude of ground water contamination at and in the vicinity of Operable Unit 2 Clean up of the ground water to achieve chemical specific ARARs will be determined on a SWMU specific basis

2 3 1 1 903 Pad Alluvial Ground Water Chemistry

Organic contamination of alluvial ground water occurs east of the 903 Drum Storage Site at well 15 87 Well 15 87 exhibited maximum concentrations of 21 μg/l chloroform ($CHCl_3$) 1 100 μg/l carbon tetrachloride (CCl_4) 120 μg/l trichloroethene (TCE) and 190 μg/l tetrachloroethene (PCE) With the exception of a one time occurrence of PCE in well 64 86 at an estimated concentration below detection limits (8 μg/l) organic contamination was not observed in any of the other alluvial wells

Estimated background concentrations of the dissolved metals barium calcium copper magnesium manganese mercury nickel potassium selenium sodium strontium and zinc are exceeded on the average in the 903 Pad alluvial wells Average concentrations of manganese nickel and selenium exceed their respective ARAR values

Major ion concentrations above background levels exist on the average for total dissolved solids chloride nitrate nitrite nitrogen sulfate and bicarbonate Total dissolved solids and sulfate levels exceed their respective ARAR values on the average for these wells

With respect to radiochemistry estimated background levels are exceeded on average for gross alpha strontium plutonium americium and total uranium However the specific radionuclides do not exceed their respective ARAR values on the average

2 3 1 2 903 Pad Bedrock Ground Water Chemistry

VOCs were detected in bedrock ground water at 01 71 02 71 and 14 87BR The highest contamination was observed at 02 71 where TCE was 1 200 μg/l Well 01 71 exhibited the highest concentrations of $CHCl_3$ CCl_4 and PCE at 330 μg/l 690 μg/l and 78 μg/l respectively

Estimated background concentrations of the dissolved metals barium calcium magnesium manganese nickel potassium selenium sodium and strontium are exceeded on the average in the 903 Pad bedrock wells Manganese and selenium exceed their respective ARAR values on the average in these wells

Major ion concentrations above estimated background levels exist on the average for total dissolved solids chloride nitrate nitrite nitrogen sulfate and bicarbonate Only total dissolved solids exceeds its ARAR value of 400 mg/l on the average

Estimated background concentrations for gross alpha plutonium americium and total uranium are exceeded on the average for the 903 Pad bedrock wells However as with the 903 Pad alluvial ground water the average concentrations of the specific radionuclides do not exceed ARAR

2 3 1 3 Mound Alluvial Ground Water Chemistry

The most notable characteristic of alluvial ground water at the Mound Area is the elevated VOC contamination in wells 35 86 and 17 87 The VOC found in the highest concentration was vinyl chloride (520 μg/l) detected in well 35 86 1 1 dichloroethene (1 1 DCE) 1 1 dichloroethane (1 1 DCA) and TCE were also detected at well 35 86 Well 17 87 had maximum concentrations of CCl_4 PCE and TCE at 71 μg/l 160 μg/l and 21 μg/l respectively

Average concentrations of the dissolved metals barium calcium copper magnesium manganese nickel potassium sodium strontium and zinc exceed estimated background concentrations in the Mound Area alluvial wells Only manganese exceeds its ARAR value on the average

Major ion concentrations above estimated background levels exist on the average for total dissolved solids chloride nitrate nitrite nitrogen sulfate and bicarbonate Only total dissolved solids exceeds its ARAR value of 400 mg/l on the average

Estimated background concentrations of americium strontium and total uranium are exceeded on the average for the Mound Area alluvial wells However these radionuclides do not exceed their respective ARAR values

The similarity of ground water major ion chemistry at the 903 Pad and Mound Areas is consistent with the hydrogeologic data showing alluvial ground water flowing from west to east across both areas The source of the low level organic contamination at 17 87 may be Trench T 1 (SWMU 108) which is located adjacent to the well or the 903 Drum Storage Area

2 3 1 4 Mound Bedrock Ground Water Chemistry

Wells 01 74 34 86 18 87 20 87 22 87 23 87 and 25 87 are the bedrock wells in the Mound Area The maximum PCE and TCE concentrations are 45 000 μg/l and 1800 μg/l respectively at well 01 74 Well 25 87 exhibited a maximum concentration of 290 μg/l of CCl_4 PCE is also observed in wells 23 87 18 87 20 87 and 25 87

Estimated background concentrations of the dissolved metals barium calcium iron magnesium manganese molybdenum potassium sodium and strontium are exceeded on the average in the Mound Area bedrock wells Only manganese exceeds ARAR on the average

Major ion concentrations above estimated background levels exist on the average for total dissolved solids chloride nitrate nitrite nitrogen sulfate and bicarbonate However only total dissolved solids exceeds ARAR

Background concentrations for gross alpha strontium and total uranium are exceeded on the average for the Mound Area bedrock wells However these specific radionuclides do not exceed their respective ARAR values

2 3 1 5 East Trenches Alluvial Ground Water Chemistry

Wells 37 86 38 86 39 86 41 86 42 86 66 86 67 86 26 87 27 87 32 87 33 87 and 35 87 are the alluvial wells at the East Trenches Area Of most significance are the elevated VOCs in the high yield well 42 86 Well 42 86 exhibits maximum concentrations of 21 $\mu g/l$ $CHCl_3$ 190 $\mu g/l$ TCE 1 100 $\mu g/l$ CCl_4 and 300 $\mu g/l$ of PCE

Average concentrations of the dissolved metals barium calcium magnesium manganese mercury nickel potassium sodium and strontium exceeded estimated background levels in the East Trenches alluvial wells however only manganese exceeds ARAR

Major ion concentrations above estimated background levels exist on the average for total dissolved solids chloride nitrate nitrite nitrogen sulfate and bicarbonate Only total dissolved solids exceeds its ARAR value of 400 mg/l on the average

Estimated background concentrations for gross alpha gross beta strontium americium and total uranium are exceeded on the average for the East Trenches alluvial wells However none of these specific radionuclides exceed their respective ARAR

2 3 1 6 East Trenches Bedrock Ground Water Chemistry

Wells 03 74 40 86 28 87 31 87 34 87 and 36 87 are the bedrock wells for the East Trenches Area Well 36 87 exhibits the highest TCE concentration (49 000 $\mu g/l$) on the RFP site CCl_4 PCE and $CHCl_3$ are also elevated in this well at average concentrations of 615 $\mu g/l$ 305 $\mu g/l$ and 140 $\mu g/l$ respectively

Estimated background concentrations of the dissolved metals barium calcium magnesium manganese molybdenum potassium sodium and strontium are exceeded on the average in the East Trenches bedrock wells Only manganese exceeds its ARAR value on the average

Major ion concentrations above estimated background levels exist on the average for total dissolved solids chloride nitrate nitrite nitrogen sulfate and bicarbonate Only total dissolved solids exceeds its ARAR value on the average

Estimated background concentrations for gross alpha gross beta and total uranium are exceeded on the average for the East Trenches bedrock wells however uranium did not exceed ARAR

Extent of Ground Water Contamination

Based on initial sampling results PCE CCl_4 TCE and $CHCl_3$ are the primary VOC contaminants found in the unconfined ground water flow system VOCs have not been detected as far east as well as 44 86 and 39 86 (South Walnut Creek drainage) or at wells 64 86 65 86 66 86 or 67 86 (Woman Creek drainage) Estimated background levels of dissolved metals major ions and radionuclides are exceeded on the average Manganese and total dissolved solids exceed ARAR values on the average for Operable Unit 2 wells

The downgradient extent of contamination in the ground water of the bedrock sandstones is unknown However hydraulic conductivity and gradient data suggest a maximum travel distance of 2 250 feet using a maximum calculated gradient of 0 09 ft/ft Additional drilling is required to determine the extent and continuity of these sandstones and possible contaminations

2 3 2 Soil Contamination

The extent of soil contamination at the 903 Pad Mound and East Trenches Areas is based on soil samples collected during Phase I RI field activities Soil samples were collected and analyzed from boreholes drilled into and adjacent to known SWMU locations Boreholes were drilled into SWMUs to the extent practical however boreholes were not drilled into SWMUs that still contain wastes (the trenches and 903 Pad) due to potential health hazards to field workers and the potential for release of waste constituents to the environment Figure 2 6 shows SWMU and borehole locations

2 3 2 1 903 Pad Area

903 Drum Storage and 903 Pad Lip Site (SWMU 112 and 155)

Based on results of the soil boring program it appears that soils surrounding the 903 Drum Storage and 903 Pad Lip Sites are contaminated with plutonium americium and phthalates (Rockwell International 1987b) Radionuclide contaminants were found only in the uppermost samples Hazardous Substances List (HSL) volatile organics were below detection limits in boreholes surrounding these sites Because volatile organics are present in ground water at these sites it is deduced that the extent of volatile organic soil contamination at the 903 Drum Storage Site is confined to the area immediately beneath and adjacent to the pad

Trench T 2 (SWMU 109)

Based on the Phase I RI results soils in the vicinity of Trench T 2 are contaminated with plutonium americium trichloroethene (TCE) 1 1 1 trichloroethane (1 1 1 TCA) tetrachloroethene (PCE) and possibly acetone and phthalates Plutonium and americium contamination is particularly high in composite soil samples that include the ground surface

Volatile organic contamination is highest south of the trench in BH25 87 Plutonium was detected in the zero to nine foot composite sample at 3 2 picocuries per gram (pCi/g) with a counting error of 0 4 pCi/g and americium was detected at 0 22 with a counting error of 0 18 pCi/g The maximum concentrations of volatile organics detected in boreholes BH25 87 were 16 000 micrograms per kilogram (μg/kg) of TCE 10 000 μg/kg of PCE 250 μg/kg of 1 1 1 TCA and 1 100 μg/kg of acetone (also detected in the blank) It is postulated that radio nuclide contamination originated from the 903 Drum Storage Site via wind dispersal and the solvent contamination is due to a release from Trench T 2 Additional surficial soil sampling is necessary in the area to determine the depth of radionuclide contamination Additional boreholes around the trench are needed to define the extent of solvent contamination

Reactive Metal Destruction Site (SWMU 140)

Solvent contamination in soils at the Reactive Metal Destruction Site was found in the vicinity of BH28 87 based on soil sampling results Tetrachloroethene at 210 μg/kg carbon tetrachloride at 100 μg/kg and carbon disulfide at 58 μg/kg were all detected below the water table in BH28 38

Plutonium was elevated above background levels in the surface and nine foot bedrock samples from BH28 87 Surficial radionuclide contamination in this area is attributed to wind dispersal of plutonium from the 903 Drum Storage Site

2 3 2 2 Mound Area

Mound Site (SWMU 113)

No volatile organic contamination was found in soil samples from the Mound Site during the Phase I investigations

Oil Burn Pit No. 2 and Trench T 1 (SWMU 153 and 108)

The draft RI Report concludes that there is not significant organic contamination of soils in the vicinity of SWMUs 108 and 153 plutonium and americium were elevated in composite surface soil samples adjacent to Trench T 1 (boreholes BH35 87 and BH36 87) Plutonium was detected at 1 5 (error of 0 2) pCi/g and americium was detected at 0 30 (error of 0 13) pCi/g in the zero to 12 foot composite sample from Borehole BH35 87 Plutonium was also detected at 0 53 (error of 0 16) pCi/g in borehole BH36 87 (zero to five foot composite sample) Because radionuclide contamination was only found in soil samples which include the ground surface wind dispersal of plutonium from the 903 Drum Storage Site is the likely source of this contaminant Surficial soils will be sampled at these sites to confirm this hypothesis

Pallet Burn Site (SWMU 154)

Analytical results of soil samples from boreholes BH31 87 and BH32 87 indicate the presence of low concentrations of HSL organics Maximum VOC levels in borehole BH31 87 were 32 μg/kg of 1 2 DCA 110 μg/kg of acetone and 20 μg/kg of PCE and maximum VOC concentrations in borehole BH32 87 were 29 μg/kg of 1 2 DCA and 170 μg/kg of acetone

2 3 2 3 East Trenches Area

Trenches, T 3, T 4, T 10, and T 11 (SWMU 110, 111 1, 111.7, and 111.8

Plutonium was elevated in the surface sample from BH39 87 at 0 82 (error of 0 12) pCi/g and 1 1 1 TCA was above detection limits in BH43 87 (maximum concentration of 130 μg/kg) BH45 87 (maximum concentration of 180 μg/kg) and BH46 87 (maximum concentration of 190 μg/kg)

Trenches T 5 through T 9 (SWMU 111.2 through 111.6)

Based on analytical results of soil samples 1 2 DCA acetone and plutonium are present in soils around the southern trenches The 1 2 DCA contamination appears to be limited to bedrock samples and acetone concentrations are also at depth Plutonium contamination is limited to the uppermost samples

2 3 3 Sediment Contamination

Sediment samples were collected during the 1986 initial site characterization from creeks and ditches that traverse the Rocky Flats Plant Surface water and sediment sampling locations are presented in Plate 1 Except for the presence of what appears to be laboratory introduced contamination (acetone and methylene chloride) HSL organics were not detected in the sediment samples along Woman and South Walnut Creeks The distribution of radionuclides is discussed below

2 3 3 1 Woman Creek

Plutonium concentrations in the sediments at sampling locations SED 1 and SED 2 on Woman Creek and its tributary were 0 06 (error of 0 02) and 0 80 (error of 0 09) pCi/g SED 2 is located on an ephemeral stream north of Woman Creek which drains the East Trenches Areas The concentrations at SED 1 and SED 2 are similar to those reported for soils in this vicinity implying that plutonium concentrations are due to resuspension and settling of contaminated dust from the 903 Pad Area (Rockwell International 1987a) Surface water stations at SED 1 (SW 1) and SED 2 (SW 2) were both dry at the time sediment samples were collected

2 3 3 2 South Walnut Creek

Plutonium and americium concentrations (pCi/g) in sediments on South Walnut Creek were as follows

Station	Plutonium	Americium
SED 11	0 02 ± 0 02	0 02 ± 0 02
SED 12	0 35 ± 0 06	0 19 ± 0 05
SED 13	0 07 ± 0 04	0 03 ± 0 03
SED 3	1 9 ± 0 1	0 42 ± 0 06

SED 3 is at Indiana Street downstream of the confluence of North and South Walnut Creeks The plutonium and americium in the sediments may result from windblown dust from the 903 Pad Area

2 3 4 Surface Water Contamination

Twenty six surface water and surface seep samples in the vicinity of the 903 Pad Mound and East Trenches Areas were collected during field activities Some of these samples contained VOCs The most contaminated samples appear to be located just north of the Mound Area and south of the 903 Pad Area Maximum concentrations of TCE PCE 1 1 DCE $CHCl_3$ CCl_4 and 1 1 1 TCA in the upper South Walnut Creek drainage north of the Mound were 62 73 133 40 605 and 33 μg/l respectively Other VOCs were not detected Maximum concentrations of TCE PCE 1 1 DCE $CHCl_3$ and CCl_4 in the seeps just southeast of the 903 Drum Storage Site were 40 65 140 84 and 1 005 μg/l respectively However the samples collected farther downstream on Woman Creek and South Walnut Creek showed no VOC contamination For example no VOCs were detected in surface water samples from the South Interceptor Ditch (Sample SW 30) Pond C 1 (Sample SW 29) Pond B 5 (Sample SW B5) and South Walnut Creek (Sample SW 25) VOCs were also not present in seeps northwest of Pond C 2 Thus VOC contamination of surface water appears to be localized in the immediate vicinity of the 903 Pad and Mound Areas

High plutonium and americium concentrations found in the seeps southeast of the 903 Drum Storage Site represent particulate forms of these radionuclides originating from contaminated soils at the surface This is concluded because

1) the seeps represent surfacing ground water and ground water does not appear to be contaminated with radionuclides

2) the seep samples contained substantial suspended solids and were not filtered prior to analysis and

3) surface soils are contaminated with plutonium in the vicinity of these seeps

Data from stations SW C1 (Pond C 1) SW 29 and SW 28 all located downstream of the 903 Pad on Woman Creek do not show any indication of radionuclide concentrations elevated above background 1986 data from station SW 25 on South Walnut Creek downstream of its southern tributary (Central Avenue Ditch) do not indicate radionuclide concentrations elevated above estimated background

2 3 5 Air Contamination

The 903 Pad Area is recognized as the principal source of airborne plutonium contamination at the Rocky Flats Plant An extensive air monitoring network known as the Radioactive Ambient Air Monitoring Program (RAAMP) is maintained at the Plant in order to monitor particulate emissions from the 903 Pad Area and other plant facilities Historically the particulate samplers located immediately east southeast and northeast of the 903 Pad Mound and East Trenches Areas have shown the highest plutonium concentrations This finding is corroborated by the results of soil surveys which indicate elevated plutonium concentrations to the east particularly southeast of the area However the RAAMP has found ambient air samples for plutonium to be well within the DOE guidelines of 20 0 x 10 ^{15} μCi/ml established for the protection of human health (Rockwell International 1987b)

2 4 ANALYTICAL DATA

Organic inorganic and radionuclide contaminants exist in ground water at Operable Unit 2 Volume II presents a compilation of volatile organic inorganic and radiochemistry data for alluvial and bedrock wells at Operable Unit 2 Volatile organic data is presented from the first and second quarters of 1989 Inorganic data is compiled from 1987 1988 and the first and second quarter of 1989

2 5 SITE CONDITIONS THAT JUSTIFY AN IRA

There is no imminent threat to the public health and environment posed by contaminants at Operable Unit 2 however localized high concentrations of VOCs in alluvial ground water at Trench T 2 (SWMU 109) the mound site (SWMU 113) and East Trenches Area (near well 42 86) represent sources for continuing contaminant release to alluvial and bedrock ground water Implementation of this IM/IRA to mitigate further releases from these locations is likely to limit future migration of significant VOC concentrations and will thus be consistent with the final remedy for the site when characterization is complete

Pursuant to the Agreement in Principle between the Department of Energy (DOE) and the Colorado Department of Health (CDH) entered into on June 16 1989 it was agreed that DOE will initiate ground water clean up at Operable Unit 2 in January 1990 This IM/IRA will therefore focus only on controlling the migration of hazardous substances in ground water originating from these Areas This IM/IRA Plan does not address soil contamination at Operable Unit 2 however a Phase II Remedial Investigation Plan is being prepared to further characterize the extent of soil contamination in preparation for further remedial actions at Operable Unit 2

SECTION 3 0

IDENTIFICATION OF INTERIM REMEDIAL ACTION OBJECTIVES

3 1 SCOPE OF INTERIM MEASURES/INTERIM REMEDIAL ACTION

The overall objective of the IM/IRA at Operable Unit 2 is the mitigation of downgradient contaminant migration of alluvial and bedrock ground water and the treatment of collected ground water to achieve acceptable levels (see below) The effort is to be performed in the interest of protecting public health as well as the environment

Specific objectives of the Operable Unit 2 IM/IRA are

- Contain reduce and or eliminate site contaminants identified as posing a threat to human health or the environment
- Reduce or eliminate exposure to site contaminants for potential receptors by controlling potential contaminant pathways and
- Demonstrate technical feasibility and environmental and cost effectiveness of the interim remedial action

3 2 INTERIM REMEDIAL ACTION SCHEDULE

IM/IRA PLAN	TIME FRAME
Draft IM/IRA Plan	September 1 1989 to November 30 1989
EPA/CDH Review	December 1 1989 to January 8 1990
Proposed IM/IRA Plan	January 9 1990 to February 6 1990
IM/IRA Plan Public Comments	February 7 1990 to March 8 1990
Respond to Public Comments and Finalize Plan	March 9 1990 to April 6 1990
DESIGN	April 9 1990 to August 17 1990
PROCUREMENT	August 6 1990 to October 1 1990
CONSTRUCTION	October 1 1990 to February 1 1991

3 3 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARAR)

Response actions at Superfund sites must meet two fundamental clean up requirements First they must attain a level of cleanup which at a minimum ensures protection of human health and the environment [CERCLA Section 121(d)(2) 42 U S C Section 9621(d)(2)] Second it is EPA policy that CERCLA cleanups attain or exceed the requirements of all applicable or relevant and appropriate Federal and state health and environmental requirements (ARARs) This section identifies and analyzes ARARs relevant to the IM/IRA at Operable Unit 2 This remedial action is considered an on site IM/IRA therefore only substantive and not administrative requirements apply

Facilities of the U S Department of Energy (DOE) are required to operate under a policy of full compliance with applicable environmental regulations while conducting their missions The DOE Albuquerque Operations Office (AL) Environmental Restoration Program is chartered to help fulfill that commitment at installations within the AL complex The proposed actions are part of this Environmental Restoration Program

The Environmental Restoration Program covers the major environmental regulations such as the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Resource Conservation and Recovery Act (RCRA) National Environmental Policy Act (NEPA) Clean Air Act (CAA) Clean Water Act (CWA) Safe Drinking Water Act (SDWA) State of Colorado Ground water Quality Standards Toxic Substances Control Act (TSCA) and Federal Insecticide Fungicide and Rodenticide Act (FIFRA) with emphasis on CERCLA and RCRA

Authority to implement the Environmental Restoration Program is primarily derived from the following DOE and AL orders

Comprehensive Environmental Response Compensation and Liability Act Program (DOE 5480 14)

Hazardous Toxic and Radioactive Mixed Waste Management (DOE 5480 2 and AL 5480 2)

Prevention Control and Abatement of Environmental Pollution (Ch XIII of DOE 5480 1 and AL 5480 1)

Environmental Protection Safety and Health Protection Information Reporting Requirements (DOE 5484 1 and AL 5484 1)

Implementation of the National Environmental Policy Act (DOE 5440 1C and AL 5440 1B)

Applicable standards may be defined as substantive environmental protection requirements criteria or limitations promulgated under Federal or state law that specifically address a hazardous substance pollutant contaminant response action location or other circumstances at a Superfund site Relevant and appropriate requirements are those substantive environmental protection requirements promulgated under federal or state law that while not jurisdictionally applicable to circumstances at the site address problems sufficiently similar to those encountered at the site that their use is well suited to the particular site ARARs must be identified on a site specific case by case basis

In general there are three categories of potential ARARs at any Superfund site These categories are

Ambient or chemical specific requirements

Locational requirements

Performance design or other action specific requirements
Each category is discussed in more detail below

3 3 1 Ambient or Chemical Specific Requirements

Ambient or chemical specific requirements set health or risk based concentration limits in various environmental media for specific hazardous substances or pollutants These requirements set protective clean up levels for the chemicals of concern in the designated media or indicate a safe level of air emission or wastewater discharge

Chemical specific ARARs are derived primarily from Federal and state health and environmental statutes and regulations Health Effects Assessments Health Advisories

Chemical Advisories and Guidance Documents may also be considered when establishing clean up standards but are not considered to be ARARs These and any proposed standards are classified as items to be considered or TBCs Where background concentrations for constituents are above the chemical specific ARAR for that constituent a variance from the ARAR is appropriate A summary of chemical specific ARARs for the contaminants found at Operable Unit 2 are presented in Table 3 1 1 through 3 1 4 Table 3 1 1 presents ARARs for organics Table 3 1 2 presents ARARs for metals Table 3 1 3 presents ARARs for conventional pollutants and 3 1 4 presents ARARs for radionuclides When more than one chemical specific ARAR has been identified for a contaminant a screening process is used to determine the specific ARAR to be applied This screening process involves three steps as outlined below

1 The lowest human health or agricultural based promulgated standard among the Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCL) and CDH ground and surface water standards is first applied (applicable)

2 For a RCRA Appendix VIII constituents in the absence of any promulgated standard in step 1 above the most stringent RCRA Land Disposal Restriction or RCRA Subpart F limit is applied (relevant and appropriate)

3 In the absence of an ARAR in steps 1 or 2 above the most stringent of the Clean Water Act Water Quality Criteria or the proposed CDH ground water and surface water standards is applied (TBC)

Screening for these ARARs is presented in Table 3 2 1 through 3 2 4 Table 3 2 1 screens ARARs for organics Table 3 2 2 screens ARARs for metals Table 3 2 3 screens ARARs for conventional pollutants and 3 2 4 screens ARARs for radionuclides The screening process includes consideration of both ground water and surface water standards because of the significant interaction of alluvial ground water and surface water in the drainages of the Rocky Flats Plant Of the elements/compounds detected in alluvial ground water at Operable Unit 2 there are no ARARs for calcium magnesium potassium sodium bicarbonate and strontium However the total dissolved solids ARAR establishes the acceptable aggregate concentration for the above major ions (excludes strontium) Until an acceptable risk based concentration is established for strontium its background concentrations is TBC

TABLE 3 1 1
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT OPERABLE UNIT 2

Chemical	Maximum In the OU 2 Alluvial Ground Water[a]	ARAR (ug/l)	Standard Criteria or Guidance	Comment
Organic Compounds				
Carbon Tetrachloride	1100	5	CDH Surface Water Drinking Water Standard is applicable	ARAR is exceeded
Chloroform	330	100	SDWA Standard for total trihalomethanes is applicable	ARAR is exceeded
1 1 Dichloroethane	59	5U	RCRA Subpart F Appendix IX Substance is TBC	TBC is exceeded
1 1 Dichloroethene	32	7	CDH Surface Water Drinking Water Standard is applicable	ARAR is exceeded
Tetrachloroethene	45 000	5U	RCRA Subpart F is R&A	ARAR is exceeded
1 1 1 Trichloroethane	63	200	CDH Surface Water Drinking Water Standard is applicable	ARAR is not exceeded
Trichloroethene	49 000	5	CDH Surface Water Drinking Water Standard is applicable	ARAR is exceeded
Vinyl Chloride	520	2	SDWA MCL is applicable	ARAR is exceeded

(a)	Maximum compound concentrations determined from first and second quarter 1989 data
ARAR	Applicable or relevant and appropriate requirements
CDH	Colorado Department of Health
MCL	Maximum Contaminant Level
R&A	Relevant and appropriate
RCRA	Resource Conservation and Recovery Act
SDWA	Safe Drinking Water Act
TBC	To be considered
U	Detection limit

TABLE 3 1 2
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT OPERABLE UNIT 2

Chemical	Maximum In the OU 2 Alluvial Ground Water[b] (mg/l)	ARAR (mg/l)	Standard Criteria or Guidance	Comment
Metals				
Aluminum	2 68	5 0	CDH Agriculture Standard is applicable	ARAR is not exceeded
Antimony	0 118	0 06U	RCRA Subpart F is R&A	ARAR is not exceeded
Arsenic	0 040	0 05	CDH Surface Water Drinking Water Standard is applicable	ARAR is not exceeded
Barium	0 932	1 0	CDH Surface Water Drinking Water Standard is applicable	ARAR is not exceeded
Cadmium	0 006	0 01	CDH Surface Water Drinking Water Standard is applicable	ARAR is not exceeded
Calcium	991	NS	No Standard	
Chromium III	0 122	05	CDH Surface Water Drinking Water Standard is applicable	Analytical result is total chromium ARAR may be exceeded
Chromium VI	0 122	05	CDH Surface Water Drinking Water Standard is applicable	Analytical result is total chromium ARAR may be exceeded
Copper	0 836	0 2	CDH Agriculture Standard is applicable	ARAR is exceeded

TABLE 3 1 2 (cont)
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT OPERABLE UNIT 2

Chemical	Maximum In the OU 2 Alluvial Ground Water[b] (mg/l)	ARAR (mg/l)	Standard Criteria or Guidance	Comment
Metals (cont)				
Iron	4 35	0 3	CDH Surface Water Drinking Water Standard is applicable	Analytical results are soluble iron soluble iron exceeds ARAR
Lead	0 024	0 05	CDH Surface Water Drinking Water Standard is applicable	ARAR is not exceeded not exceeded
Lithium	0 22	2 5	CDH Ground Water Standard is applicable	ARAR is not exceeded
Magnesium	136	NS	No Standard	
Manganese	1 27	0 05	CDH Surface Water Drinking Water Standard is applicable	Analytical results are soluble manganese ARAR is exceeded
Mercury	0 013	0 002	CDH Surface Water Drinking Water Standard is applicable	ARAR is exceeded
Molybdenum	0 135	0 1	CDH Agriculture Standard is applicable	ARAR is not exceeded
Nickel	1 41	0 2	CDH Agriculture Standard is applicable	ARAR is exceeded
Potassium	31	NS	No Standard	
Selenium	0 37	0 01	CDH Surface Water Drinking Water Standard is applicable	ARAR is exceeded

TABLE 3 1 2 (cont)
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT OPERABLE UNIT 2

Chemical	Maximum In the OU 2 Alluvial Ground Water[b] (mg/l)	ARAR (mg/l)	Standard Criteria or Guidance	Comment
Metals (cont)				
Silver	0 128	0 05	CDH Surface Water Drinking Water Standard is applicable	ARAR is not exceeded
Sodium	405	NS	No Standard	
Strontium	2 9066	NS	No Standard	Background is TBC
Vanadium	0 245	0 1	CDH Agriculture Standard is applicable	ARAR is not exceeded
Zinc	2 77	2 0	CDH Agriculture Standard is applicable	ARAR is exceeded

(b) Maximum compound concentrations determined from 1987 and 1988 database
ARAR Applicable or relevant and appropriate
CDH Colorado Department of Health
NS No standard
R&A Relevant and appropriate
RCRA Resource Concentration and Recovery Act
U Detection limit

TABLE 3 1 3
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT OPERABLE UNIT 2

Chemical	Maximum In the OU 2 Alluvial Ground Water[b] (mg/l)	ARAR (mg/l)	Standard Criteria or Guidance	Comment
Conventional Pollutants				
Nitrite	15 4	1 0	CDH Ground Water Standard is applicable	Analytical results are total nitrate plus nitrate nitrogen ARAR is exceeded
Nitrate	15 4	10 0	CDH Ground Water Standard is applicable	Analytical results are total nitrate nitrogen Results indicate that nitrate ARAR is exceeded
Chloride	947	250	CDH Ground Water Standard is applicable	ARAR is exceeded
Sulfate	1157	250	CDH Ground Water Standard is applicable	ARAR is exceeded
Bicarbonate as $CaCO_3$	642	NS	No Standard	
T D S	3219	400	CDH Ground Water Standard is applicable	ARAR is exceeded

(b) Maximum compound concentrations determined from 1987 and 1988 database
ARAR Applicable or relevant and appropriate requirements
CDH Colorado Department of Health
NS No standard
TDS Total dissolved solids

TABLE 3 1 4
CHEMICAL SPECIFIC ARARs
FOR COMPOUNDS AND ELEMENTS DETECTED
AT OPERABLE UNIT 2

Chemical	Maximum In the OU2 Alluvial Ground Water[b] (pCi/l)	ARAR (pCi/l)	Standard Criteria or Guidance	Comment
Radionuclides				
Gross Alpha	250	15	CDH Ground Water Standard is is applicable	ARAR is exceeded
Gross Beta	327	50	SDWA MCL is applicable	ARAR is exceeded
$Pu^{238\ 239\ 240}$	0 522	15	CDH Surface Water Standard is applicable	ARAR is not exceeded
Am^{241}	0 831	4	CDH Surface Water Standard is applicable	ARAR is not exceeded
H^3	560	20 000	CDH Surface Water Standard is applicable	ARAR is not exceeded
$Sr^{89\ 90}$	5 0	8	CDH Surface Water Standard is applicable	ARAR is not exceeded
$Uranium^{total}$	62	40	CDH Surface Water Standard is applicable	ARAR is exceeded

(b)	Maximum compound concentrations determined from 1987 and 1988 database
Am	Americium
ARAR	Applicable or relevant and appropriate
CDH	Colorado Department of Health
H^3	Tritium
MCL	Maximum Contaminant Level
Pu	Plutonium
SDWA	Safe Drinking Water Act
Sr	Strontium
TBC	To be considered

TABLE 3 2 1
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO OPERABLE UNIT 2 IM/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (ug/l)	CDH Ground Water Quality Standards[b] (ug/l)	SDWA Maximum Contaminant Level (MCL)[c] (ug/l)	For Use In Special Circumstances SDWA/MCLG[d] (ug/l)	RCRA Land Disposal Restrictions (ug/l)[k]	CWA Ambient Water Quality Criteria for Protection of Aquatic Life Freshwater Acute/Chronic (ug/l)	CDH Surface Water Quality Standards[e] (ug/l)	ARAR (ug/l)	Comment
Organic Compounds									
Carbon Tetrachloride	5U	5	5	0	50	35 000/	5	5	CDH Surface Water Drinking Water Standard is applicable
Chlorofo m	5U	0 19	100[j]			28 000/1 200[g]	0 19	5U	CDH Surface Water and Fish Ingestion Standard (0 19 ug/l) is BDL so detection limit of 5 ug/l is applicable
1 1 Dichloroethane	5U[m]							5U	RCRA Subpart F is TBC[l]
1 1 Dichloroethene	5U	7	7	7		11 000[g]/	7	7	CDH Surface Water Drinking Water Standard is applicable
Tetrachloroethene	5U	0 8		0[g]	79	5 200/840[g]	0 8	5U	CDH Surface Water Fish and Water Ingestion Standard (0 8 ug/l) is BDL so detection limit of 5 ug/l is applicable

TABLE 3 2 1 (cont)
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO OPERABLE UNIT 2 IM/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (ug/l)	CDH Ground Water Quality Standards[b] (ug/l)	SDWA Maximum Contaminant Level (MCL)[c] (ug/l)	For Use In Special Circumstances SDWA/MCLG[d] (ug/l)	RCRA Land Disposal Restrictions (ug/l)[k]	CWA Ambient Water Quality Criteria for Protection of Aquatic Life Freshwater Acute/Chronic (ug/l)	CDH Surface Water Quality Standards[e] (ug/l)	ARAR (ug/l)	Comment
Organic Compounds (cont)									
1 1 1 Trichloroethane	5U[m]	200	200	200	1 050		200	200	CDH Surface Water Drinking Water Standard is applicable
1 1 2 2 Tetrachloroethane	5U			0[g]	7			5U	RCRA Subpart F is R&A
Trichloroethene	5U	5	5	0	62	45 000/21 000[g]	5	5	CDH Surface Water Drinking Water Standard is applicable
Vinyl Chloride	10U	2	2	0[g]				2	SDWA MCL and CDH ground water quality standard is applicable

(a) 40 CFR Part 264 92 Subpart F releases from solid waste management units (40 CFR 261 Appendix VIII List of Hazardous Constituents)
(b) 5 CCR 1002 8 Section 3 11 5 Basic Standards for Ground Water August 17 1989
(c) 40 CFR Part 141 61 National Primary Drinking Water Standards
(d) 40 CFR Part 141 50 National Primary Drinking Water Standards
(e) 5 CCR 1002 8 Section 3 8 29 Temporary Rule Adopted July 11 1989
(g) Lowest observed effect level
(i) To be considered The most recent EPA Guidance on the identification of ARARs states that existing criteria advisories guidance or proposed st ndards should be considered for a chemical in the absence of p omulgated st ndard
(j) Pr posed value Oct 1986
(k) 40 CFR Part 268 41 Subpart D Treatment Stand ds
(m) RCRA 40 CFR 264 Append x IX G ound W ter Monit ring List S bst nce Not Included in 40 CFR 261 Append VIII List f H a d s Constitue ts

ARAR Applicable or relevant and appropriate requirements
BDL Below detection limits
CDH Colorado Department of Health
LDR Land disposal restrictions
MCL Maximum contaminant level
MCLG Maximum contaminant level goal
RCRA Resource Conservation and Recovery Act
SDWA Safe Drinking Water Act
TBC To be considered
U Detection limit

TABLE 3 2 2
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO OPERABLE UNIT 2 IM/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (mg/l)	CDH Ground Water Standard Human Health/ Agriculture[b] (mg/l)	SDWA Maximum Contaminant Level (MCL)[c] (mg/l)	For Use In Special Circumstances SDWA/MCLG (mg/l)	CWA Ambient Water Quality Criteria for Protection of Aquatic Life Freshwater Acute/Chronic (mg/l)	CDH Surface Water Quality Standard[d] Drinking Water/ Agriculture (mg/l)	ARAR (mg/l)	Comment
Metals								
Aluminum		/5 0					5 0	CDH Agriculture Standard is applicable
Antimony	0 06U				9 0/1 6		0 06U	RCRA Subpart F is R&A
Arsenic	0 05	0 05/0 1	0 05		0 8[g]/ 048[g]	0 05/0 1	0 05	CDH Surface Water Drinking Standard is applicable
Barium	1 0	1 0/	1 0	1 5[f]			1 0	CDH Surface Water Drinking Water Standard is applicable
Cadmium	0 01	0 01/0 01	0 01	0 005	0 0039[h]/0 0011[h]	0 01/0 01	0 01	CDH Surface Water Drinking Water Standard is applicable
Calcium							NS	No Standard
Chromium III	0 05 (tot)	0 05/0 1			1 7[h]/0 2[h]	0 05/0 1	05	CDH Surface Water Drinking Water Standard is applicable
Chromium VI	0 05 (tot)	0 05/0 1	0 05	0 0012	0 016/ 011	0 05/0 1	05	CDH Surface Water Drinking Water Standard is applicable
Copper	0 046	1 0/0 2	1 0	1 3[f]	0 018[h]/0 012[h]	1 0/0 2	0 2	CDH Agriculture Standard is applicable
Iron		0 3/5 0	0 3			0 3/	0 3	CDH Surface Water Drinking Water Standard is applicable

TABLE 3 2 2 (cont)
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO OPERABLE UNIT 2 IM/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (mg/l)	CDH Ground Water Standard Human Health/ Agriculture[b] (mg/l)	SDWA Maximum Contaminant Level (MCL)[c] (mg/l)	For Use In Special Circumstances SDWA/MCLG (mg/l)	CWA Ambient Water Quality Criteria for Protection of Aquatic Life Freshwater Acute/Chronic (mg/l)	CDH Surface Water Quality Standard[d] Drinking Water/ Agriculture (mg/l)	ARAR (mg/l)	Comment
Metals (cont)								
Lead	0 05	0 05/0 1	0 05	0 002[f]	0082[h]/ 0032	0 05/0 1	0 05	CDH Surface Water Drinking Water Standard is applicable
Lithium		2 5					2 5	CDH Ground Water Standard is applicable
Magnesium							NS	No Standard
M ng nese		0 05/0 2	0 05			0 05/0 2	0 05	CDH Surface Water Drinking Water Standard is applicable
Mercury	0 002	0 002/0 01	0 002	0 003	0024/ 000012	0 002	0 002	CDH Surface Water Drinking Water Standard is applicable
Molybdenum		/0 1					0 1	CDH Agriculture Standard is applicable
Nickel	0 0185	/0 20			1 8[h]/ 096[h]	/0 2	0 2	CDH Agriculture Standard is applicable
Potassium							NS	No Standard
Selenium	0 01	0 01/0 02	0 01	0 045[f]	0 26/0 35	0 01/0 02	0 01	CDH Surface Water Drinking Water Standard is applicable
Silver	0 05	0 05/	0 05		0041[h]/ 00014	0 05/	0 05	CDH Surface Water Drinking Water Standard is applicable
Sodium							NS	No Standard

TABLE 3 2 2 (cont)
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO OPERABLE UNIT 2 IM/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (mg/l)	CDH Ground Water Standard Human Health/ Agriculture[b] (mg/l)	SDWA Maximum Contaminant Level (MCL)[c] (mg/l)	For Use In Special Circumstances SDWA/MCLG (mg/l)	CWA Ambient Water Quality Criteria for Protection of Aquatic Life Freshwater Acute/Chronic (mg/l)	CDH Surface Water Quality Standard[d] Drinking Water/ Agriculture (mg/l)	ARAR (mg/l)	Comment
Metals (cont)								
Strontium							NS	Background is TBC
Vanadium	0 024	/0 1					0 1	CDH Agriculture Standard is applicable
Zinc	0 0517[J]	5 0/2 0	5 0		0 32[h]/0 047[h]	5 0/2 0	2 0	CDH Agriculture Standard is applicable

(a) 40 CFR Part 264 92 Subpart F Releases from solid waste management units
(b) 5 CCR 1002 8 Section 3 11 5 Ground Water Quality Standards
(c) 40 CFR Part 141 11 National Primary Drinking Water Standards
(d) 5 CCR 1002 8 Section 3 8 29 Temporary Rule adopted July 11 1989 (Total Recoverable Concentrations)
(f) Proposed value as of October 1986
(g) Lowest Observed Effect Level
(h) Hardness dependent criteria (100 mg/l)
(J) RCRA 40 CFR 264 Appendix IX Ground Water Monitoring List Substance not Included in 40 CFR 261 Appendix VIII List of Hazardous Constituents
ARAR Applicable or relevant and appropriate
CDH Colorado Department of Health
CWA Clean Water Act
MCL Maximum Contaminant Level
MCLG Maximum Contaminant Le el Goal
NS No standard
R&A Relevant and Appropriate
RCRA Resource Conservation and Recovery Act
SDWA Safe Drinking Water Act

TABLE 3 2 3
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO OPERABLE UNIT 2 IM/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (mg/l)	CDH Ground Water Standard Human Health/ Agriculture[b] (mg/l)	SDWA Maximum Contaminant Level (MCL)[c] (mg/l)	For Use In Special Circumstances SDWA/MCLG (mg/l)	CWA Ambient Water Quality Criteria for Protection of Aquatic Life Freshwater Acute/Chronic (mg/l)	CDH Surface Water Quality Limited Standard[d] Drinking Water/ Agriculture (mg/l)	ARAR (mg/l) unless otherwise noted	Comment
Conventional Pollutants								
Nitrite		1 0 as N/ 10 0 as N				1[g]/10[h]	1 0	CDH Ground Water Standard is applicable
Nitrate		10 0 as N/ 100 as NO_2+NO_3 N	10			10[i]/100[h]	10 0	CDH Ground Water Standard is
applicable								
Chloride		250/	250			250/	250	CDH Ground Water Standard is applicable
Sulfate		250/	250[f]			250/	250	CDH Ground Water Standard is applicable
Bicarbonate as $CaCO_3$							NS	No Standard
T D S		400 mg/l or 1 25 times background whichever is least restrictive	500[f]				400	CDH Ground Water Standard is applicable

(a) 40 CFR Part 264 92 Subpart F releases from solid waste management units
(b) 5 CCR 1002 8 Section 3 11 5 Groundwater Quality Standards
(c) 40 CFR Part 141 11(b c) National Primary Drinking Water Standards
(d) 5 CCR 1002 8 Section 3 8 29 Temporary Rule Adopted July 11 1989
(f) 40 CFR Part 143 3 National Secondary Drinking Water Standards
(g) To be applied at th point of water supply intake
(h) In order to provide such a reasonable margin of safety to allow for unusual situations such as extremely high water ingestion or nitrite formation in sl ies the NO_3 N plus NO_2 N content in d i king w ters f li estock and poult y h ld be limited to 100 ppm or less and the NO_2 N content alo e be limited t 10 ppm or less
(i) A combined tot l f Nit it nd Nitrate at the point f int ke to the domestic t pply h ll t ceed 10 mg/l

ARAR Applicable or relevant and appropriate requirements
CDH Colorado Department of Health
CWA Clean Water Act
MCLG Maximum contaminant level goal
N
NS No standard
RCRA Resource Conservation and Recovery Act
SDWA Safe Drinking Water Act

TABLE 3 2 4
SCREENING OF CHEMICAL SPECIFIC ARARs
PERTINENT TO OPERABLE UNIT 2 IM/IRA OPTIONS

Chemical	RCRA Subpart F Concentration Limit[a] (pCi/l)	CDH G ound Water Quality Standards[b] (pCi/l)	SDWA Maximum Contaminant Level (MCL)[c] (pCi/l)	For Use In Special Circumstances SDWA/MCLG[d] (pCi/l)	CWA Ambient Water Quality Criteria for Protection of Aquatic Life Freshwater Acute/Chronic (pCi/l)	CDH Surface Water Quality Standards[e] (pCi/l)	ARAR (pCi/l)	Comment
Radionuclides								
Gross Alpha		15	15				15	CDH Ground Water Standard is applicable
Gross Beta		4 mrem/yr[e]	50				50	SDWA MCL is applicable
$Pu^{238\ 239\ 240}$		15	40[f]			15	15	CDH Surface Water Standard is applicable
Am^{241}			4[f]			30	4	CDH Surface Water Standard is applicable
H^3		20 000	20 000			20 000	20 000	CDH Surface Water Standard is applicable
$Sr^{89\ 90}$		8	8			8	8	CDH Surface Water Standard is applicable
$Uranium^{total}$						40	40	CDH Surface Water Standard is applicable

(a) 5 CCR 1002 8 Section 3 11 5(B) Basic Standards Applicable to Ground Waters of the State
(b) 40 CFR Parts 141 15 16 National Primary Drinking Water Standards
(c) 5 CCR 1002 8 Section 3 8 29 Temporary Rule Adopted July 11 1989
(e) For beta and photon emitters if two or more radionuclides are present the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem per year Except for Tritium and Strontium 90 the concentration of man made radionuclides causing 4 mrem total body or organ dose equivalents shall be calculated on the basis of a 2 liter per day drinking w ter intake using the 168 hour data listed in Maximum Permissible Body Burd n and Ma imum Pe missible Concentration of Radionuclides in Air or W ter for Occupational Exposu NBS H ndbo k 69 s amended August 1963 US D partment of Comme ce
(f) P oposed v lue dri k g ater yi lding a isk eq l t that from a dose te f 4 m em/ ye Septembe 30 1986 (51 FR 34859)

Am	Americium
ARAR	Applicable or relevant and appropriate requirements
CDH	Colorado Department of Health
CWA	Clean Water Act
H^3	Tritium
MCL	Maximum contaminant level
MCLG	Maximum contaminant level goal
Pu	Plutonium
RCRA	Resource Conservation and Recovery Act
SDWA	Safe Drinking Water Act
Sr	Strontium

3 3 1 1 Safe Drinking Water Act Maximum Contaminant Levels (MCLs) and MCL Goals

Because ground water at Operable Unit 2 is a potential source of drinking water Maximum Contaminant Levels (MCLs) are relevant and appropriate for all phases of the IM/IRA MCLs are derived from the Safe Drinking Water Act (PL 93 523) They represent the maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a public water system [40 CFR 141 2(C)] Maximum Contaminant Level Goals (MCLGs) have also been considered in developing clean up standards Section 121(d) of CERCLA as amended by SARA suggests that MCLGs may be appropriate under certain circumstances of the release or threatened release of hazardous substances This is reinforced in EPA s document entitled Draft CERCLA Compliance with Other Laws Manual, Volume II, Maximum Contaminant Level Goals, that identifies the special circumstances where MCLGs should be considered as ARAR These circumstances generally occur when there are multiple contaminants in ground water or where multiple pathways of exposure present extraordinary risks According to the guidance document the use of MCLGs should be determined on a site specific basis in consultation with EPA headquarters

The clean up criteria for the IM/IRA at Operable Unit 2 consider MCLs and MCLGs as ARAR wherever such standards have been promulgated for the contaminants of concern Proposed MCLs and MCLGs are considered TBCs in this analysis

3 3 1 2 Ambient Water Quality Criteria

The Ambient Water Quality Criteria are non enforceable guidance developed under the Clean Water Act Guidance is set for surface waters for the protection of aquatic life and for the protection of human health based on both drinking water and consuming aquatic organisms from that water Since the IM/IRA proposed here involves the treatment and subsequent discharge to surface water the Water Quality Criteria are considered TBC

3 3 1 3 Colorado Surface and Ground Water Quality Standards

The Colorado Department of Health (CDH) has adopted interim ground water quality standards for many organic compounds These are considered applicable for the constituents where they exist Some of the standards are lower than the current standard detection limits for the compounds of concern When this occurs the detection limit will be considered as ARAR

The CDH has also promulgated ground water quality standards for many inorganic compounds for both human health and agricultural uses These standards are considered to be applicable since future or downgradient use of the aquifer is not restricted Where standards exist for both human health and agricultural uses the more stringent standard is considered to be the ARAR

On July 11 1989 the CDH adopted temporary surface water quality standards for Walnut Creek and Woman Creek These include standards for many organic inorganic and radionuclide parameters These temporary standards are in effect until March 30 1990 (unless permanent standards are adopted at an earlier date) and are considered applicable

3 3 1 4 RCRA Ground Water Protection Standards

Owners or operators of facilities that treat store or dispose of hazardous waste must ensure that hazardous constituents listed in 6 CCR 1007 3 and 40 CFR 264 Appendix VIII entering the ground water from a regulated unit do not exceed concentration limits under 6 CCR 1007 3 and 40 CFR 264 94 The concentration limits include standards for 14 compounds with background used as the standard for the other RCRA Appendix VIII constituents These concentration limits apply to RCRA regulated units subject to permitting (landfills surface impoundments waste piles and land treatment units) that received RCRA hazardous waste after July 26 1982 Although this area does not contain RCRA regulated units it does contain SWMUs Therefore the RCRA clean up criteria of background concentrations for Appendix

VIII constituents is relevant and appropriate and are used to define ARARs in the absence of any human health based standards Background concentration for 40 CFR 264 Appendix IX constituents not listed in Appendix VIII are TBC

RCRA land disposal restrictions (LDRs) for certain organic contaminants (40 CFR Part 268 40) are considered relevant and appropriate for the discharge of treated ground water to either a surface or ground water body The LDRs are technology based standards and are considered relevant and appropriate in the absence of a health based standard

3 3 2 Locational Requirements

Locational requirements are statutes or regulations which set restrictions on activities or limits on contaminant levels depending on the characteristics of a site or its immediate environs Examples of locational requirements are Federal and state citing laws for hazardous waste facilities or sites on the National Register of Historic Places Also included are the Wilderness Protection Act and floodplain regulations promulgated pursuant to the Federal Emergency Management Agency s National Flood Insurance Program Location specific ARARs that are relevant and appropriate are the State of Colorado citing criteria for RCRA treatment units and for surface water discharges the CDH Water Quality Division s regulations pertaining to pre approval of treatment facility location

3 3 3 Performance, Design, or Other Action Specific Requirements

Performance design or other action specific requirements set controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants These requirements are not triggered by the specific chemicals present at a site but rather by the particular IM/IRA alternatives that are evaluated as part of this plan Action specific ARARs are technology based performance standards such as the Best Available Technology (BAT) standard of the Federal Water Pollution Control Act Other examples include RCRA treatment storage and disposal standards and Clean Water Act pretreatment standards for discharges to publicly owned treatment works (POTWs) Action specific ARARs for the interim remedial actions evaluated here are included in Table 3 3

TABLE 3 3
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Treatment	BDAT standards for spent solvent wastes and dioxin containing wastes are based on one of four technologies or combinations for waste waters (1) steam stripping (2) biological treatment or (3) carbon absorption [alone or in combination with (1) or (2)] and for all other wastes incineration Any technology may be used however if it will achieve the concent ation levels specified	Effective November 8 1988 disposal of contaminated soil or debris resulting from CERCLA response actions or RCRA corrective actions is subject to land disposal prohibitions and/or treatment standards established for spent solvent wastes dioxin containing wastes and California List wastes	RCRA Sections 3004(d)(3) (e)(3) 42 U S C 6924(d)(3) (e)(3)	Applicable	Movement of excavated soil on site or transportation of soil off site for disposal must be treated to attain levels achievable by best demonstrated available treatment technologies before being land disposed
Capping	Placement of a cap over waste (e g closing a landfill or closing a surface impoundment or waste pile as a landfill or similar tion) equires a c ver designed and constructed to Provide long term minimization migration of liquids through the capped area Function with minimum maintenance Promote drainage and minimize erosion or abrasion of the cover Accommodate settling and subsidence so that the cover s integrity is maintained and Have a permeability less than or equal to the permeability of any bottom liner system or n t l sub soils present	RCRA hazardous waste placed at site after November 19 1980 or movement of hazardous waste from one unit area of contamination or location into nother unit r area of contamination will make requirements applicable Capping without such movement will not make requirement applicable but technical requirements are likely to be relevant and appropriate	40 CFR 264 258(b) 40 CFR 264 310(a)	R&A	Capping of waste in place using RCRA technical requirements R&A

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Capping (cont)	Eliminate free liquids stabilize wastes before capping (surface impoundments)		40 CFR 264 228(a)		
	Restrict post closure use of property as necessary to prevent damage to the cover		40 CFR 264 117(c)		
	Pre ent runon and runoff from damaging cover		40 CFR 264 228(b) 40 CFR 264 310(b)		
	Protect and maintain surveyed benchmarks used to locate waste cells (landfills waste piles)		40 CFR 264 310(b)		
	Eliminate free liquids by removal or solidification		40 CFR 264 228(a)(2)		
	Stabilization of remaining waste and waste residues to support cover		40 CFR 264 228(a)(2) and 40 CFR 264 258(b)		
	Installation of final cover to provide long term minimization of infiltration		40 CFR 264 310		
	Post closure care and ground water monitoring		40 CFR 264 310		

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Clean Closure	General performance standard requires minimization of need for further maintenance and control minimization or elimination of post closure escape of hazardous waste hazardous constituents leachate contaminated runoff or hazardous waste decomposition products Disposal or decontamination of equipment structures and soils	RCRA hazardous waste (listed or characteristic) placed at site after November 19 1980 or movement of hazardous waste from one unit area of contamination or location into another unit or area of contamination Not applicable to material undisturbed since November 19 1980	40 CFR 264 111	R&A	Applicable to soil excavated for off site disposal
		May apply to surface impoundment contaminated soil including soil from dredging or soil disturbed in the course of drilling or excavation and returned to land	40 CFR 264 111		
	Removal or decontamination of all waste residues contaminated cont inment system components (e g liners dikes) contaminated subsoils and structures and equipment contaminated with waste and leachate and management of them as hazardous waste		40 CFR 264 228(a)(1) and 40 CFR 264 258		
Excavation/ Consolidation	Meet health based levels at unit		40 CFR 244 111		
	Area from which materials are excavated may require cleanup to levels established by closure requirements	Movement of hazardous waste (listed or characteristic) from one unit or area of contamination into another Consolidation within a unit or area of contamination does not trigger applicability	See Clean Closure	R&A	RCRA requirements for clean closure are R&A to remedial action involving soil excavation
	Consolidation in storage piles/storage tanks will t igger storage requirements			R&A	RCRA requirements for storage in waste piles or tanks are relevant and appropriate for interim storage of excavated soil destined for consolidation or off site disposal

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Excavation/ Consolidation (cont)	Placement on or in land outside unit boundary or area of contamination will trigger land disposal requirements and restrictions		40 CFR 268 (Subpart D)	R&A	Soil excavated during installation of french drains is subject to land disposal restrictions for solvent containing waste Requirements are applicable for RCRA hazardous waste R&A if not RCRA hazardous waste
Ground Water Diversion	Excavation of soil for construction of slurry wall may trigger cleanup or land disposal restrictions	RCRA hazardous waste placed at site after November 19 1980 or movement hazardous waste from one unit area of contamination or location into another unit or area of contamination	See Excavation/ Consolidation	R&A	See Excavation/Consolidation
Treatment or Storage in Tanks	Tanks must have sufficient shell strength (thickness) and for closed tanks pressure controls to assure that th y do not oll pse or rupture	RCRA hazardous waste (listed or characteristic) held for temporary period before treatment disposal or storage elsewh (40 CFR 264 10) in a tank	40 CFR 264 190	R&A	Relevant and Appropriate for treatment and storage tanks used in treating contaminated ground water
	Waste must not be incompatible with the tank material unless the tank is protected by a liner or by other means		40 CFR 264 191		
	New tanks or components must be provided with secondary containment		40 CFR 264 193		
	Tanks must be provided with controls to prevent overfilling and sufficient freeboard maintained in open tanks to prevent overtopping by wave action or precipitation		40 CFR 264 194		

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Treatment or Storage in Tanks (cont)	Inspect the following overfilling control control equipment monitoring data waste level (for uncovered tanks) tank condition above ground portions of tanks (to assess their structural integrity) and the area surrounding the tank (to identify signs of leakage)		40 CFR 264 195		
	Repair any corrosion crack or leak		40 CFR 264 196		
	At closure remove all hazardous waste and hazardous waste residues from tanks discharge control equipment and discharge confinement structures		40 CFR 264 197		
	Store ignitable and reactive waste so as to prevent the waste from igniting or reacting Ignitable or reactive wastes in covered tanks must comply with buffer zone requirements in Flammable and Combustible Liquids Code Tables 2 1 through 2 6 (National Fire Protection Association 1976 or 1981)		40 CFR 264 198		
Container Storage (On Site)	Containers of hazardous waste must be	RCRA hazardous waste (listed or characteristic) held for a temporary period before treatment disposal or storage elsewhere in a container (i e any portable device in which a material is stored transported disposed of or handled) (40 CFR 264 10)		R&A	RCRA container storage requirements are R&A
	Maintained in good condition		40 CFR 264 171		

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Container Storage (On Site) (cont)	Compatible with hazardous waste to be stored and		40 CFR 264 172		
	Closed during storage (except to add or remove waste)		40 CFR 264 173		
	Inspect container storage areas weekly for deterioration		40 CFR 264 174		
	Place cont iners on a sloped crack free base and protect from contact with accumulated liquid Provide containment system with a capacity of 10% of the volume of containers of free liquids Remo e spilled or leaked waste in a timely manner to prevent overflow of the containment system		40 CFR 264 175		
	Keep containers of ignitable or reactive waste at least 50 feet from the facility s property line		40 CFR 264 176		
	Keep incompatible materials separate Separate incompatible materials stored near each other by a dike or other barrier		40 CFR 264 177		

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Container St rage (On Site) (cont)	At closure remove all hazardous waste and residues from the containment system and decontaminate or remove all containers liners		40 CFR 264 178		
Off Site Treatment Storage or Disposal	In the case of any removal or remedial action involving the transfer of any hazardous substance or pollutant or contaminant off site such hazardous substance or pollutant or contaminant shall only be transferred to a facility which is operating in compliance with section 3004 and 3005 of the Solid Waste Disposal Act (or where applicable incompliance with the Toxic Substances Control Act or other applicable Federal law) and all applicable State requirements Such substance or pollutant or contaminant may be transferred to a land disposal facility only if the President determines that both of the following requirements are met The unit to which the hazardous substance or pollutant or contaminant is transferred is not releasing any hazardous waste or constituent thereof into the ground water or surface water or soil		SARA section 121(d)(2)(C)	Applicable	Applicable to the off site treatment storage or disposal of wastes generated during on site remedial actions

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Off Site Treatment Storage or Disposal (cont)	All such releases from other units at the facility are being controlled by a corrective action program approved by the Administrator under subtitle C of the Solid Waste Disposal Act				
Hazardous Waste Operation	As mandated by SARA OSHA has promulgated regulations that require employers to develop and implement a written safety/health program designed to regulate employee safety and health during hazardous waste operations The safety and health program must include	Regulations apply to hazardous substance response operations under CERCLA corrective cleanup under RCRA hazardous waste operations that have been designated for cleanup by state or local authorities most operations involving the treatment storage or disposal of hazardous wastes regulated under RCRA and emergency response operations for releases or threats of releases of hazardous substances	29 CFR Part 1910 120		
	<u>Organizations structure</u> Establish and implement chain of command and specify the responsibilities of key personnel				
	<u>Comprehensive work Plan</u> Identify anticipated activities define work tasks establish personnel requirements and provide for the implementation of medical surveillance and training programs as required by these regulations				

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Hazardous Waste Operation (cont)	Site Specific Health and Safety Plans A site health and safety plan must be prepared for each phase of operation that addresses key personnel hazard recognition training assignments personnel protective equipment to be used medical surveillance frequency and type of monitoring including air and personal monitoring site control measures decontamination procedures emergency contingency plans				
	General Requirements of these regulations				
	Site characterization and analysis Identify site hazards to determine levels of personnel protection		29 CFR 1910 120(c)	Applicable	Site hazards have been characterized through the RI/FS process
	Site Control Implement site control zones to minimize employee exposure to hazardous substances		29 CFR 1910 120(d)	Applicable	Site control zones will be defined in site specific health and safety plans
	Training Initial training and refresher training required before employee is permitted to engage in site activities		29 CFR 1910 120(e)	Applicable	Personnel engaged in remedial actions at Operable Unit 2 are required to meet minimum training requirements as specified in the OSHA standards

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Pr requisite	Citation	ARAR	Comments
Hazardous Waste Operation (cont)	Medical Surveillance Employers must implement medical surveillance for employees potentially exposed to hazardous substances		29 CFR 1910 120(f)	Applicable	
	Engineering Controls, work practices and personnel protective equipment One or all of these shall be used to minimize exposure of employees to hazardous substances and health hazards		29 CFR 1910 120(g)	Applicable	
	Monitoring Monitoring of exposures of employees to hazardous substances is required to determine the efficacy of protective equipment and engineering controls		29 CFR 1910 120(h)	Applicable	
	Informational Programs Employees contractors and subcontractors shall be informed of the degree and nature of hazards associated with site activities		29 CFR 1910 120(i)	Applicable	All personnel involved in site activities will be required to read and comply with the site safety plan The safety plan will outline the anticipated physical and chemical hazards
	Material Handling Hazardous substances contaminated soils liquids or other residues shall be handled transported and labeled according to subsection (j) of the OSHA standard		29 CFR 1910 120(j)	Applicable	D O T specification containers will be used to handle store or transport

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Hazardous Waste Operation (cont)	Decontamination Decontamination procedures outlined in subsection (k) of the standard must be complied with during on site remedial action		29 CFR 1910 120(k)	Applicable	Decontamination procedures will be presented in the site health and safety plan
	Emergency Response Contingency plans must be developed as part of site health and safety planning		29 CFR 1910 120(l)	Applicable	Contingency plans will be developed for the site health and safety plan
	Illumination/Sanitation Minimum illumination and sanitation facilities must be provided for employees involved in hazardous waste operations		29 CFR 1910 120(m)(n)	Applicable	
	Site Excavation Site excavations msut be shored or sloped to prevent collapse		29 CFR 1910 120/1926	Applicable	
	Contractors and Subcontractors Employers must inform contractors or subcontractors of potential hazards associated with site activities		29 CFR 1910 120	Applicable	

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Hazardous Waste Operation (cont)	Permissible Exposure Levels (PEL) and Short Term Exposure Level (STEL) OSHA establishes PELs for substances amending its Air Contaminants Standard OSHA has reviewed health risk and feasibility evidence for all substances for which PELs and STELs are established		29 CFR 1910 1000	Applicable	
Discharge of Storm Waters	Requires storm water discharges to be permitted under the Federal (or state) National Pollution Discharge Elimination Systems (NPDES) program Different requirements are applicable for different classes and types of discharges		40 CFR 122 21(g) 40 CFR 122 26 and 40 CFR 122 28	R&A	Applicable to the discharge of storm waters on site
Discharge of Water into Surface Water Bodies	An NPDES permit is required for discharging water into surface water bodies		40 CFR 122 and 40 CFR 125	R&A	The remedial alternatives at Operable Unit 2 may include the discharge of treated or untreated ground water
Effluent Guidelines and Standards Pre Treatment Standards	This section establishes pre treatment standards (both general and categorical) for the control of pollutant discharges into Public Owned Treatment Works (POTW) Discharge of POTW must not cause pass through interference violation of specific prohibitions or violations of local limitations or ordinances POTW should either have an EPA approved pre treatment program or have sufficient me hanisms to meet the requi ements of the nati n l pre treatment program in accepti g CERCLA waste		40 CFR 403 5	R&A	The remedial alternatives at Operable Unit 2 may include discharges of pre treated ground water to POTWs

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Discharge of Treatment System Effluent (cont)	Use of best available technology (BAT) economically achievable is required to control toxic and non conventional pollutants Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants Technology based limitations may be determined on a case by case basis		40 CFR 122 44	R&A	The remedial alternatives at Operable Unit 2 may include the discharge of treatment system effluent
U S EPA Ground Water Protection Strategy	The strategy includes guidelines on classifying ground water for EPA decisions affecting ground water protection and corrective actions Criteria include ecological importance replaceability and vulnerability consideration	The protection strategy does not involve applicable ARARs but does contain policy statements to be considered		TBC	This strategy is to be considered regarding ground water remedial alternatives for Operable Unit 2
National Ambient Air Quality	National ambient air quality standards have been set to attain and maintain primary and secondary standards to protect public health and the environment Requirements include a major source permit prevention of significant deterioration permit non attainable area permit and visibility permit		CAA Section 109 and 40 CFR 50	R&A	Remedial actions at Operable Unit 2 that may result in new sources of air emissions include incineration excavation and air stripping of contaminated ground water
New Source Performance Standards	Standards for new sources of air emissions Requirements are source spe ific	Need to determine if these standards apply to potential remedial actions	CAA Section III	R&A	

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Transportation of Hazardous Materials	Specific DOT requirements exist for l beling packaging shipping papers/manifesting and transporting by rail aircraft vessel and highway		49 CFR 100 199	R&A	Applicable to wastes or materials shipped off site
Environmental Impact of Federal Actions	A statement of en ironmental impact is required Establishes provisions applicable to and binding on all federal agencies for implementing the procedural requirements of the National Environmental Policy Act (NEPA) Includes procedures for planning (Part 1501) preparing environmental impact statements (part 1502) d cision making (P t 1505) and compliance (Part 1507)		NEPA Section 102(2)(c) and 40 CFR 1500 1508 DOE 5440 1C	R&A	
Worker Safety	Occupational Safety and Health program for DOE contractor employees at government owned contractor operated facilities		DOE 5483 1A	Applicable	
Emergency Planning Preparedness and Response for Operations	Provide coordination direction of planning preparedness and response to operational emergencies in which there is a potential for personal injury destruction of property theft or release of toxic radioactive or other hazardous material which present a potential threat to health safety or the en ironment		DOE 5500 2	Applicable	

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
General Environmental Protection Program	Establishes environmental protection program requirements authorities and responsibilities for DOE operations for ensuring compliance with federal and state environment protection laws and regulations federal executive orders and internal department policies		DOE 5400 1	Applicable	
Environmental Compliance Issue Coordination	Establishes DOE requirements for coordination of significant environmental compliance issues		DOE 5400 2A	Applicable	
Hazardous and Radioactive Mixed Waste Program	Establishes DOE hazards and radioactive mixed waste policies and requirements and implements RCRA		DOE 5400 3	Applicable	
Radiation Protection	Establishes radiation protection standards and requirements including occupationally related exposure of individuals in controlled areas		DOE 5480 1	Applicable	
Packaging and Transportation of Hazardous Materials Hazardous Sub stances hazardous wastes and radioactive materials	Establishes requirements for packaging and transportation		DOE 5480 3	Applicable	
Comprehensive Environmental Response Compensation and Liability Act Program	Establishes basic requirements for implementation of the Superfund at DOE facilities		DOE 5480 14	Applicable	

TABLE 3 3 (cont)
SCREENING OF PROBABLE ACTION SPECIFIC ARARs
FOR REMEDIAL ACTIONS AT OPERABLE UNIT 2

Action	Requirement	Prerequisite	Citation	ARAR	Comments
Environmental Protection Safety and Health Protection Information Reporting Requirements	Establishes requirements and procedures for reporting information having environmental protection safety or health significance for DOE operations		DOE 5484 1	Applicable	
Radioactive Waste Management	Establishes policies and guidelines by which DOE manages radioactive waste waste byproducts and radioactively contaminated surplus facilities		DOE 5820 2A	Applicable	

SECTION 4 0

IDENTIFICATION AND ANALYSIS OF IM/IRA ALTERNATIVES

4 1 SUMMARY OF TECHNOLOGIES AND IRA ALTERNATIVE DEVELOPMENT

In order to develop IM/IRA alternatives for Operable Unit 2 several individual remedial technologies were first identified which deal with the environmental issues and contaminant pathways as well as address the objectives of the IM/IRA The selection of these technologies was based on the screening of numerous remedial technologies presented in the Feasibility Study Report and the IM/IRA Plan for the adjacent 881 Hillside Area (Rockwell International 1988 and Rockwell International 1989 respectively) The 881 Hillside Area has similar environmental and contaminant characteristics as Operable Unit 2 The following preferred technologies were selected for development of remedial action alternatives

Ground Water Collection

selective pumping of existing wells

subsurface (french) drains and

well arrays

Ground Water Treatment

UV/Peroxide or granular activated carbon (GAC) for organic contaminant removal and

ion exchange water treatment for inorganic contaminant removal

These technologies with the exception of UV/Peroxide treatment were combined to form IM/IRA alternatives that address clean up of ground water at Operable Unit 2 The rationale for selecting GAC over UV/peroxide is presented in Section 4 3 The three IM/IRA alternatives are as follows

1 Selective pumping of existing high contamination/high yield monitoring wells continuous treatment for organic and inorganic contaminants at a centrally located treatment facility discharge treated water into South Walnut Creek at Pond B 5

2 Collection of contaminated ground water using a french drain continuous treatment for organic and inorganic contaminants at a centrally located treatment facility and discharge treated water into South Walnut Creek at Pond B 5

3 Collection of contaminated ground water using a line of downgradient wells (well array) continuous treatment for organic and inorganic contaminants at a centrally located treatment facility and discharge treated water into South Walnut Creek at Pond B 5

4 2 IM/IRA ALTERNATIVE SCREENING PROCESS

4 2 1 Effectiveness

The criteria for effectiveness evaluation of remedial alternatives includes protection and the use of alternatives to land disposal Protection includes protection of the community and workers during the remedial action threat reduction (mitigation of identified threats) determination of the length of time until protection is achieved compliance with chemical and location specific ARARs compliance with criteria advisories and guidance description of potential exposure to residuals remaining on site and long term reliability for providing continued protection The effectiveness criteria also includes use of alternatives to land disposal thus promoting utilization of treatment or recycling instead of land disposal

4 2 2 Implementability

The criteria for implementability evaluation of remedial alternatives includes technical feasibility availability and administrative feasibility Technical feasibility includes the ability to construct the technology maintain its operation compliance with action specific ARARs ability to meet process efficiencies or performance goals demonstrated performance evaluation of impact of environmental conditions and compliance with the SARA requirement that removal actions should contribute to the efficient performance of long term remedial action to the extent practicable Availability includes the availability of necessary equipment materials and personnel availability of adequate off site treatment storage and disposal capacity if appropriate and description of post remedial site controls which will be required at the completion of the action Administrative feasibility includes the likelihood of public acceptance of the alternative including state and local concern coordination of activities with other agencies and ability to obtain any necessary approvals or permits

4 2 3 Costs

The criteria for evaluation of cost of remedial alternatives includes total cost and statutory limits Total cost includes direct capital costs indirect capital costs and any post removal site control costs Since the IM/IRA at Operable Unit 2 is not an EPA financed remedial action the $2 million statutory cost limit does not apply

4 3 PREFERRED GROUND WATER TREATMENT TECHNOLOGY

The screening process previously described has been used to select the preferred ground water treatment system The preferred treatment process for the interim action is a carbon adsorption/ion exchange system The rationale for selecting these unit processes is summarized below The units are more fully described in subsequent sections along with a discussion of their effectiveness and implementability As part of the final remedial action the choice of treatment technology will be re evaluated

Granular Activated Carbon (GAC) has been selected as the treatment technology for organic contaminant removal at Operable Unit 2 because it is a proven technology and requires little or no process supervision In general the ground water collected for treatment under this IM/IRA will be comprised of a combination of low yield/ highly contaminated well water or intercepted ground water and high yield/moderately contaminated water Because the low yield wells may not be capable of providing a consistent flow for treatment influent concentrations of organics could vary widely GAC is more flexible and effective than UV/peroxide treatment in removing organics over a wide range of flow and concentration UV/peroxide treatment is not as flexible because influent (and effluent) organic concentra tions must be monitored continuously to ensure adequate peroxide dosage for complete organic destruction and to prevent carry over of excess peroxide to down line treatment units Reliable on line dosage controls for variations in influent quality do not exist

Ion exchange treatment for inorganic contaminants was selected as the appropriate treatment technology for the 881 Hillside Area IM/IRA after a thorough evaluation of alternatives This evaluation is presented in the IM/IRA for the 881 Hillside Area (Rockwell International 1989) Ion exchange treatment remains the selected treatment alternative for inorganic contaminants at Operable Unit 2

4 3 1 Activated Carbon Adsorption (Organic Contaminant Removal)

4 3 1 1 Description

For the granular activated carbon (GAC) adsorption system the ground water will be pumped through two GAC columns in series operated in a downflow fixed bed mode (Figure 4 1) To completely utilize the carbon columns are arranged in series allowing the lead column to become fully exhausted before regeneration while the second (polishing) column ensures effluent quality Periodic samples will be taken from the effluent of each unit When the lead unit effluent exceeds chemical specific ARARs for organic contaminants the lead carbon column will be removed the polishing (second) column will become the lead column and a replacement carbon column will be put in service as the polishing unit The carbon column with the exhausted carbon will then be shipped to an off site location for regeneration

4 3 1 2 Effectiveness

GAC adsorption systems have been shown to remove VOCs from contaminated ground water to levels that comply with the chemical specific ARARs The EPA (*Federal Register* Vol 52 No 130 page 25698) has designated carbon adsorption a Best Available Technology for the removal of seven specific volatile organic compounds (including TCE and PCE) from

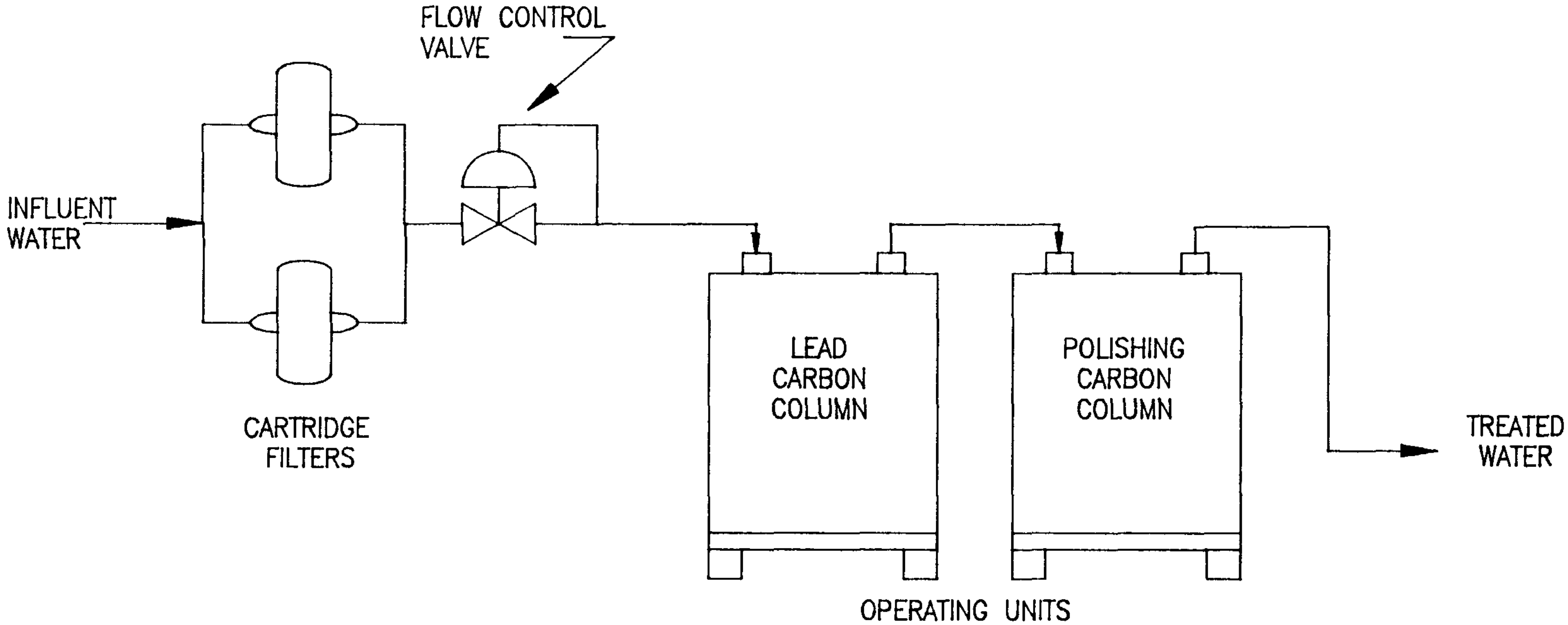


FIGURE 4-1
CARBON ADSORPTION TREATMENT UNIT

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drinking water The GAC adsorption system that is proposed here for the treatment of Operable Unit 2 ground water will be in continuous operation until the concentrations of VOCs in the influent ground water decrease to specified chemical specific ARAR concentrations at which time further treatment will be unnecessary

OSHA standards relating to construction safety (29 CFR Part 1926) and hazardous waste operation (29 CFR Part 1910 120) will be followed during all operations The system will be operated and maintained by personnel who are trained in the handling of hazardous and radioactive wastes Because carbon will remove oxygen from the air precautions must be taken to ensure that an adequate air supply is available when personnel are working in confined areas

The operators of the GAC system will not be exposed to VOC laden carbon because the use of the containerized and transportable carbon contactors allows removal and replacement of the exhausted carbon at a remote carbon reactivation site Carbon will not be handled at the site Transporting the entire exhausted carbon column to the regeneration facility ensures operators are protected from exposure to contaminated carbon

The exhausted carbon is regenerated off site through a thermal treatment process which strips the volatile organics from the carbon At least two companies with RCRA permits or interim status exist During regeneration organics are destroyed via incineration During this regeneration process a small quantity of ash may be generated which requires disposal at a landfill Thus this process can be considered an alternative to land disposal since the carbon is continuously recycled However if the spent carbon was determined to be a mixed waste then it would require land disposal at the Nevada Test Site

GAC adsorption treatment in sealed fixed bed contactor vessels does not produce any waste streams or vapor emissions The safety of nearby communities will not be adversely affected and the risk of harm to the environment is not increased This treatment process will effectively remove organic contaminants from the ground water Treated water will be monitored at the effluent and also at an intermediate point in the system to ensure contaminants are below the chemical specific ARAR concentrations before being released to the environment during implementation of the process

4 3 1 3 Implementability

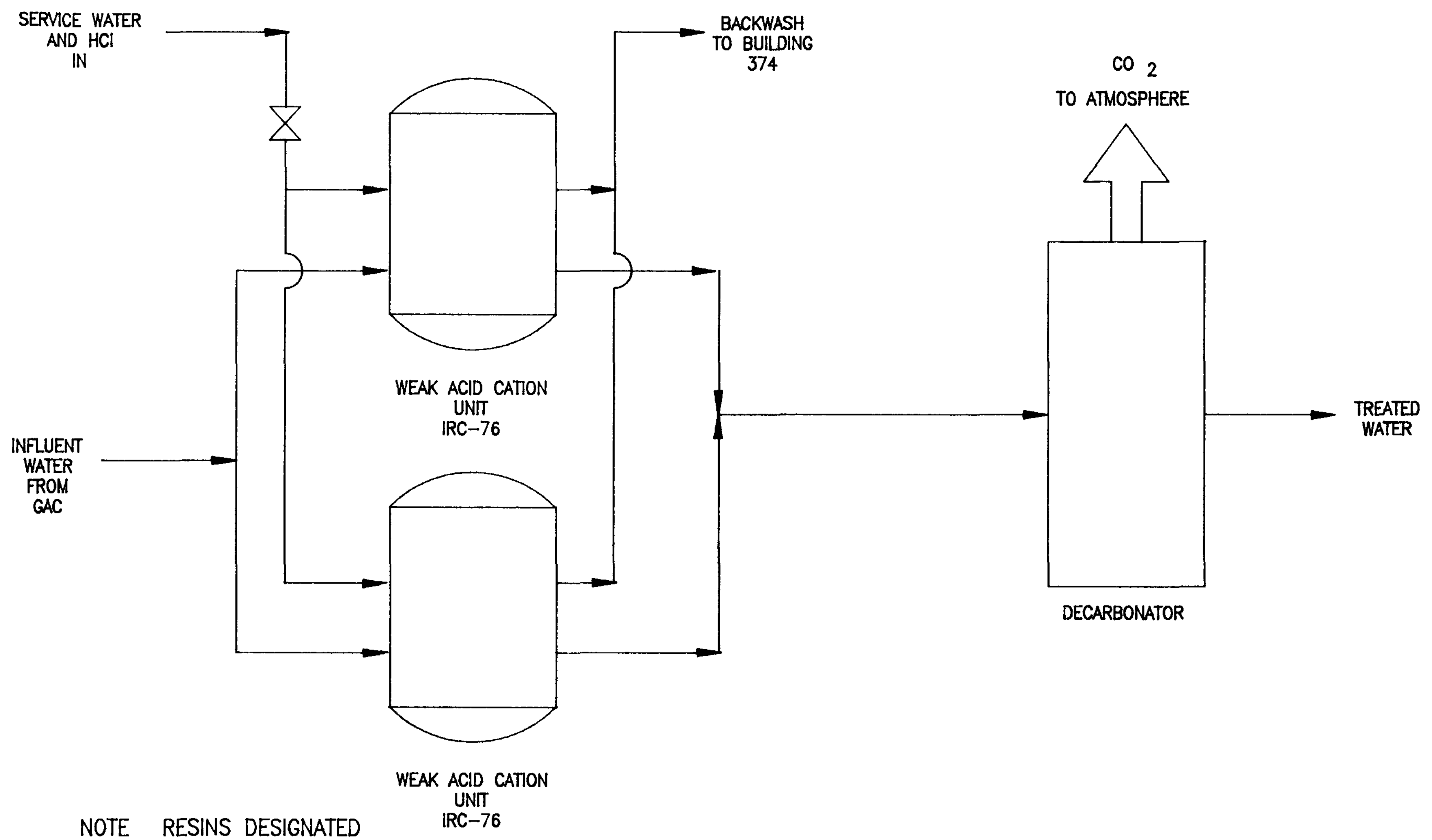
GAC adsorption is a proven technology for removing volatile organic compounds (VOCs) from ground water A second carbon unit connected in series with the lead unit would serve as a polishing unit and will ensure removal of the VOCs to meet chemical specific ARARs The carbon columns can be shipped and readily installed in the treatment building The system should be ready to operate at full capacity after initial adjustments and test runs within one week

It is estimated that approximately 4 man hours of operator time will be needed daily or 120 hours per month primarily for start up shutdown and system monitoring

4 3 2 Ion Exchange Treatment (Inorganic Contaminant Removal)

4 3 2 1 Description

The ion exchange treatment system consists of dual weak acid cation exchange units arranged in parallel to remove manganese and reduce total dissolved solids in the ground water (Figure 4 2) The influent to the treatment system is expected to contain total dissolved solids and manganese concentrations in excess of ARARs Regardless of the ground water collection alternative the weak acid cation exchanger will remove bicarbonate alkalinity and in so doing will reduce the total dissolved solids concentration in the effluent Other bivalent cations will also be effectively removed The system will be operated in parallel one unit will operate on line at all times while the other unit is being regenerated Because the weak acid cation exchanger produces carbonic acid from the removal and exchange of bicarbonate hardness a decarbonator (air stripper) is provided down line to convert the carbonic acid to



NOTE RESINS DESIGNATED BY ROHM & HAAS

FIGURE 4-2

ION EXCHANGE TREATMENT UNIT

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carbon dioxide The carbon dioxide is released to the atmosphere from the decarbonator Effluent water will be used to backwash and regenerate each unit The unit will require periodic regeneration with hydrochloric acid (HCl) Use of acids will require that operators are aware of this potential hazard The backwash will be comprised of excess HCl and primarily calcium chloride ($CaCl_2$) Regeneration wastes will be sent to the Building 374 Process Waste Treatment System for final treatment and disposal

4 3 2 2 Effectiveness

Ion exchange treatment technology has been proven to remove inorganic contaminants from ground water to levels that comply with the chemical specific ARARs Resins used to exchange contaminants require regeneration to maintain treatment levels

OSHA standards relating to construction safety (29 CFR Part 1926) and hazardous waste operations (29 CFR Part 1910 120) will be followed during all operations The system will be operated and maintained by personnel that are properly supervised and trained Treated water will be monitored to ensure that the removal of inorganic contaminants is achieved prior to discharge to the environment

The weak acid cation exchange resin operated in the hydrogen form has several advantages for removal of inorganic contaminants at Operable unit 2 The resin has a high regeneration efficiency high operating exchange capacity for bicarbonate hardness and a strong affinity for heavy metals Rohm and Haas IRC 76 is the resin selected for its ability to remove manganese and trace metals In addition the bicarbonate is transformed by the exchange of hydrogen ions with calcium and magnesium to produce carbonic acid Carbonic acid is removed in a decarbonator where carbon dioxide is vented to the atmosphere The removal of bicarbonate hardness results in a reduction of total dissolved solids below the required chemical specific ARAR of 400 mg/l

The safety of nearby communities will not be adversely affected The risk of harm to the environment is not increased as this treatment process will effectively remove inorganic contaminants from the ground water

4 3 2 3 Implementability

Ion exchange technology utilizes specific resins to remove by chemical exchange heavy metals and total dissolved solids Resins are selected based on contaminants to be removed Ion exchange units are commercially available off the shelf systems that can be purchased and installed readily The operation of ion exchangers require the resins to be periodically regenerated before treatment can resume The regenerated waste products will require additional treatment in the Building 374 Process Waste Treatment System

The proposed system is designed for ease of operation and minimizes the volume of regeneration wastes requiring treatment in the Building 374 Process Waste Treatment System It is estimated that the system will require 150 man hours per month for operating maintenance and monitoring The majority of this time is required during the regeneration periods

4 3 3 Summary of Preferred Ground Water Treatment System

As discussed above activated carbon adsorption has been selected for the removal of organic contaminants and ion exchange for the removal of inorganic contaminants In order to maximize the overall system performance the ground water will be treated as shown in the general treatment system flow diagram in Figure 4 3

As shown in this figure the ground water will initially be pumped into equalization tanks The equalization tanks will provide more process control by ensuring a constant flow for the treatment plant These tanks also provide limited storage of ground water when the treatment system is not operating The water is filtered to remove suspended solids and then

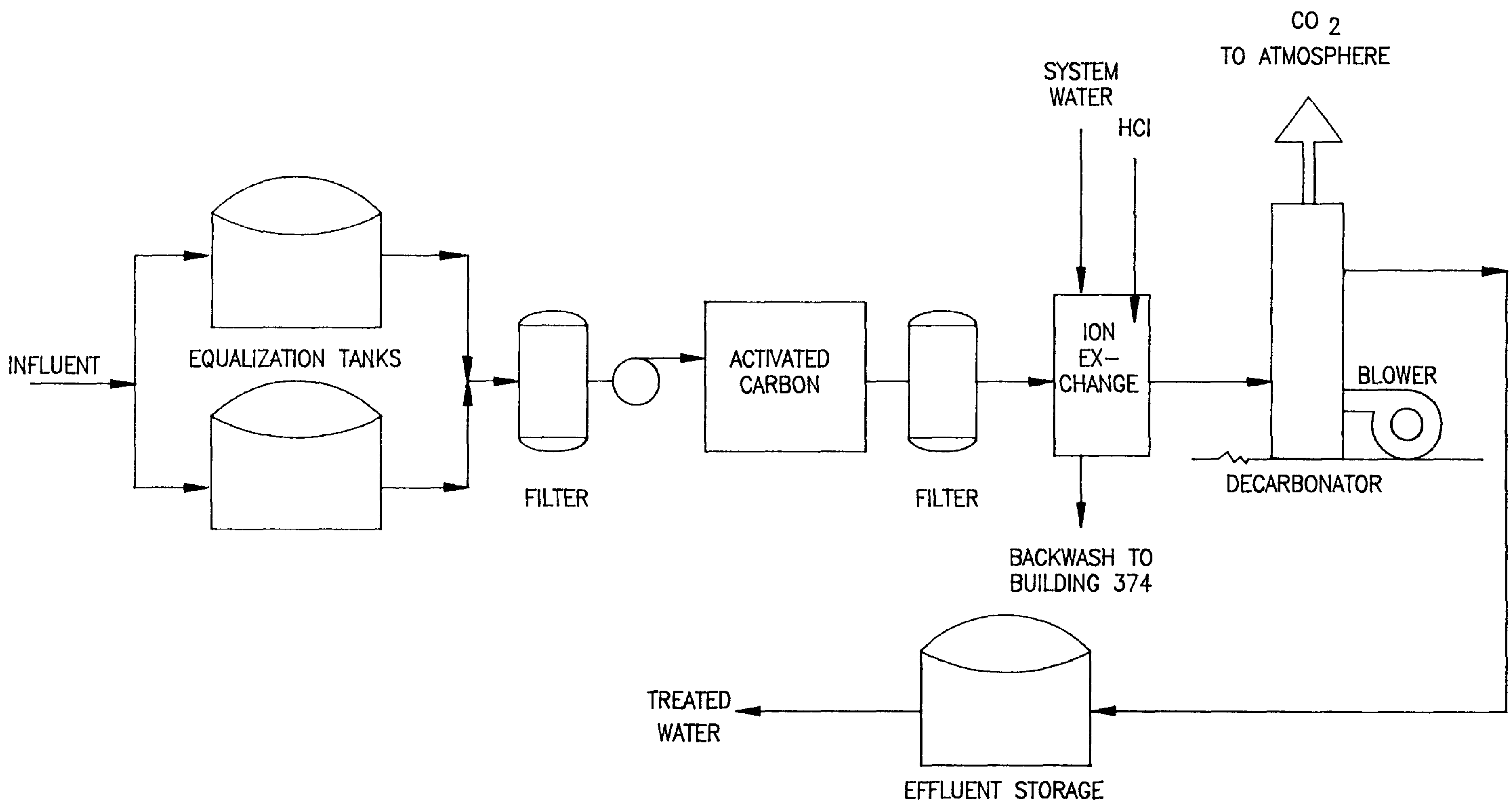

FIGURE 4-3
GENERAL TREATMENT SYSTEM FLOW DIAGRAM

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sent to the GAC units where the organic contaminants are removed Water is filtered again to prevent carbon carry over and then passed through the ion exchange units for the removal of inorganic contaminants During system operation the regenerant wastes from the ion exchange resins are stored and periodically transported by tanker to Building 374 for final treatment By placing the GAC units before the ion exchange units the organic contaminants are removed first This ensures that no organic contaminants could end up in the waste stream sent to Building 374 Sending wastes containing organic contaminants to Building 374 is undesirable

4 4 ANALYSIS OF IM/IRA ALTERNATIVES

4 4 1 Alternative 1. Selective Pumping of Existing Wells, Treatment, Discharge Treated Water into South Walnut Creek at Pond B 5

4 4 1 1 Description

This alternative involves the collection of ground water from existing alluvial and bedrock monitoring wells located throughout Operable Unit 2 as shown in Figure 4 4 The alternative mitigates contaminated ground water migration by withdrawing ground water containing elevated levels of VOCs from selected wells Wells were selected by identification of those wells with the greatest contaminant mass flux potential e g wells with potentially high sustained yields and/or wells with high concentrations of contaminants Characteristics of wells with significant VOC contamination (total > 0 5 ppm) are shown in Table 4 1 Figure 4 5 is a plot of the log of total VOC concentration (average of first and second quarter 1989 data) against the log of the well yield for selected Operable Unit 2 wells As illustrated in the figure ground water at wells 2 71 36 87BR 25 87BR 1 71 1 74 and 42 86 has the greatest mass flux potential and thus have been selected for pumping Table 4 2 presents the chemical characteristics of the combined flow from wells 01 71 02 71 01 74 25 78BR and 36 87BR and well 42 86 The 30 day average combined flow from wells 01 71 02 71 01 74 25 87BR and 36 87BR is 9 5 gpm for well 42 86 the flow is 33 gpm

TABLE 4 1 CHARACTERISTICS OF SELECTED CONTAMINATED WELLS

Area	Well	Sum of Volatiles[1] (ug/l)	Completion Material[2]	Hydraulic Conductivity[3] (cm/s)	Saturated Thickness (ft)	30 Day Average Flow[4] (gpm)
903 Pad	1 71	1 116	Bedrock	$5x10^{4}$	15	1 5
	2 71	844	Bedrock	$5x10^{4}$	14	1 3
	11 87BR	1 426	f g Sandstone	$5x10^{4}$	3 2	0 079
	12 87BR	1 446	f g Sandstone	$5x10^{4}$	2 8	0 061
Mound	15 87	1 426	Sandy Gravel	$1x10^{3}$	3 4	0 17
	1 74	40 802	Bedrock?	$4x10^{5}$	8	0 046
East Trench	3 74	1 181	Bedrock?	$4x10^{5}$	4	0 012
	25 87BR	952	m g Sandstone	$5x10^{4}$	20 2	2 7
	36 87BR	31 622	f g Sandstone	$3x10^{4}$	31 2	3 9

Notes

1 Sum of Volatiles are averages of the first two quarters of 1989 data for all wells except 11 87BR and 12 87BR for which 1989 data was not available so averages of 1987 and 1988 data were used

2 Questioned completion material descriptions are based on a comparison of potentiometric data and the top of bedrock elevation f g fine grained m g - medium grained

3 Hydraulic conductivities based on test results for 1 74 25 87BR and 36 87BR All others are estimates based on material descriptions in drilling logs (11 87BR 12 87BR and 15 87) or on estimates of probable material in which the wells are completed (3 74 1 71 and 2 71)

4 30 day average flows calculated using variable flow to constant drawdown well and assuming that drawdown is equal to the saturated thickness Although the flow rates can be expected to drop further as they approach steady state these flow rates are conservatively estimated and can be used for conceptual design

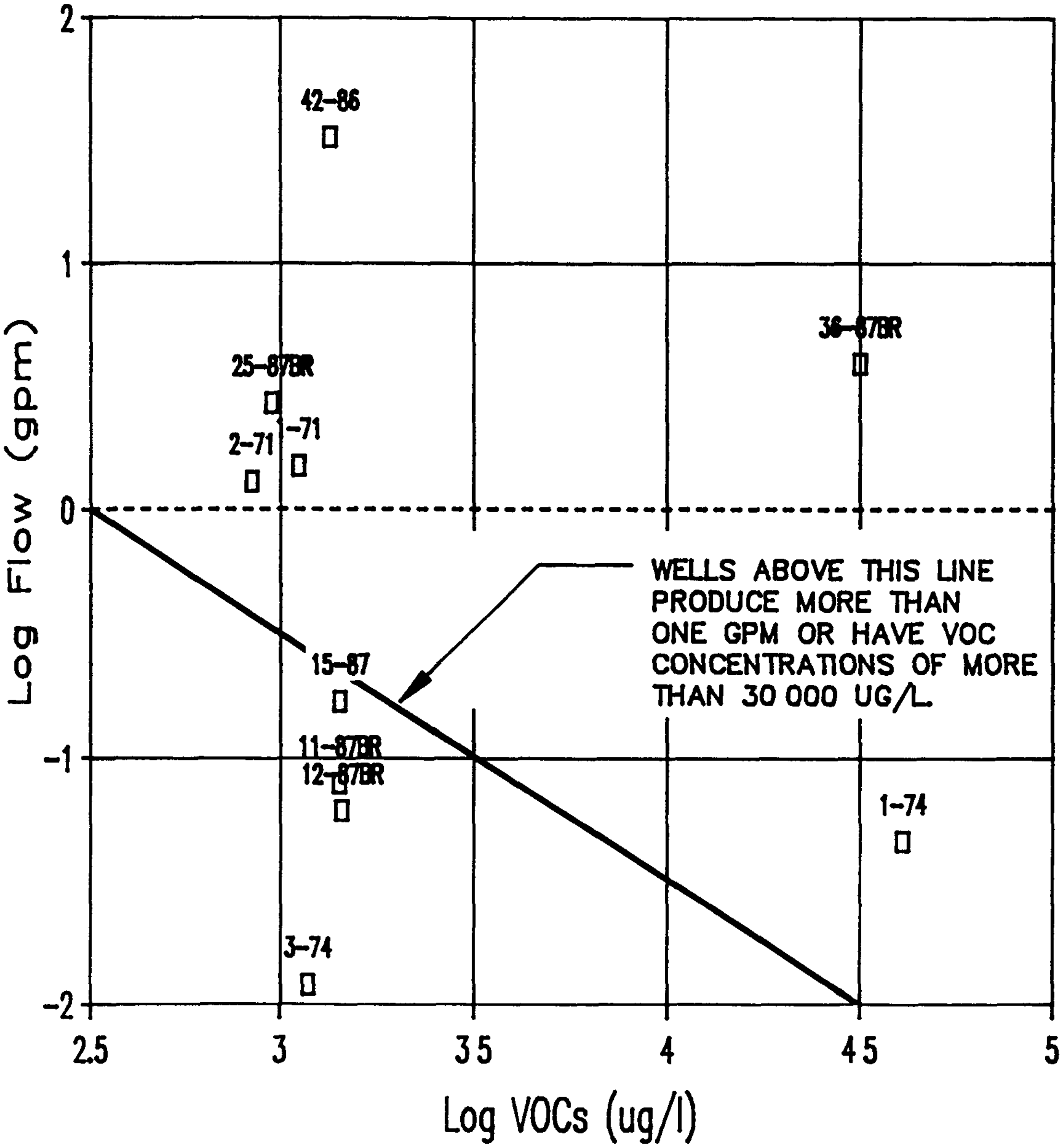

FIGURE 4-5
POTENTIAL VOLATILE FLUX DIAGRAM

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TABLE 4 2

BASIS FOR DESIGN OF ALTERNATIVE 1 TREATMENT PLANT

Organics	Units	Influent Low Yield Wells[a]	Influent Well 42 86	Treatment Require-Ments
Chloroform	µg/l	100	21	100
Trichloroethene	µg/l	12 716	143	5
Carbon Tetrachloride	µg/l	414	930	5
1 1 Dichloroethene	µg/l	13	3	7
1 1 1 Trichloroethane	µg/l	15	3	200
Tetrachloroethene	µg/l	498	240	5
1 1 Dichloroethane	µg/l	4	3	5
Metals				
Aluminum	mg/l	0 15	0 41	5 0
Antimony	mg/l	0 018	0 017	0 06
Arsenic	mg/l	0 003	0 003	0 05
Barium	mg/l	0 15	0 22	1 0
Beryllium	mg/l	0 001	0 001	0 1
Cadmium	mg/l	0 002	0 002	0 01
Cesium	mg/l	0 02	0 03	NS
Chromium	mg/l	0 01	0 007	0 05
Copper	mg/l	0 005	0 012	0 20
Iron	mg/l	0 31	0 22	0 30
Lead	mg/l	0 003	0 04	0 05
Manganese	mg/l	0 13	0 055	0 05
Mercury	mg/l	0 001	0 002	0 002
Molybdenum	mg/l	0 011	0 011	0 10
Nickel	mg/l	0 029	0 04	0 20
Selenium	mg/l	0 006	0 003	0 01
Silver	mg/l	0 004	0 02	0 05
Strontium	mg/l	0 42	0 44	NS
Thallium	mg/l	0 005	0 005	0 01
Vanadium	mg/l	0 02	0 03	0 1
Zinc	mg/l	0 03	0 02	2 0
Major Ions				
Calcium	mg/l	105	133	NS
Magnesium	mg/l	12	12	NS
Potassium	mg/l	1 4	1 4	NS
Sodium	mg/l	40	16	NS
Total Dissolved Solids	mg/l	492	434	400

TABLE 4-2 (cont)

BASIS FOR DESIGN OF ALTERNATIVE 1 TREATMENT PLANT

Major Ions (cont.)	Units	Influent Low Yield Wells[a]	Influent Well 42 86	Treatment Require-Ments
Chloride	mg/l	87	41	250
Nitrite & Nitrate	mg/l	5 3	4 5	10
Sulfate	mg/l	59	26	250
Bicarbonate as $CaCO_3$	mg/l	203	240	NS
Radionuclides				
Gross Alpha	pCi/l	9 5	48 6	15
Gross Beta	pCi/l	7 6	32 0	50
Uranium (total)	pCi/l	5 6	3 74	40
Strontium (89 90)	pCi/l	no data	0 90	8
Plutonium (239 240)	pCi/l	0 006	0 11	15
Americium (241)	pCi/l	0 02	0 0025	4
Tritium	pCi/l	185	205	20 000

[a] Based on a flow weighted average of wells 36 87 25 87 1 74 1 71 and 2 71 Averages computed from the 1987 and 1988 databases with the exception of organics Organic compound concentrations determined from first and second quarter 1989 data

NS No standard

A process flow diagram for this alternative is shown in Figure 4 6 The existing monitoring wells will be redrilled to their existing total depth to accommodate new well pumps The ground water will be withdrawn using either centrifugal or air activated pumps The flow from each well will be piped via buried pipeline directly to influent equalization tanks located inside a newly constructed treatment facility building Flow from each well will be metered for the purposes of monitoring the quantity of ground water collected The treatment facility will be located north of the eastern Plant access road and immediately west of the western boundary of the East Trenches Area (see Figure 4 4) Buried pipelines will route around the boundaries of SWMUs to prevent disturbing potentially contaminated soil and exposing personnel to hazardous substances

The flow from wells 1 71 2 71 1 74 25 87BR and 36 87BR will be combined and segregated from the flow of well 42 86 The flows will be segregated because the chemical characteristics of ground water at well 42 86 are such that it will not require treatment for inorganic contaminants Flow from well 42 86 will be pumped via pipeline directly to a dedicated influent equalization tank A separate influent storage tank will be utilized for the ground water withdrawn from the other wells The ground water will be pumped and treated continuously Influent and effluent equalization tanks will provide limited storage capacity to attenuate flows and provide treated water (effluent tank) for maintenance of treatment units Power for the treatment plants and well pumps will be provided from the existing Plant electric service

The ground water collected will be treated using granular activated carbon (for organics removal) and an ion exchange system (for inorganics removal) A new building will be erected for enclosure of the water treatment system to protect weather or temperature sensitive components Fire protection within the building will be provided by two wall mounted 25 pound dry chemical type fire extinguishers The building and all treatment units shall be non combustible construction Other than minimal files and records no combustible materials will be maintained within the building Major components of the treatment system include

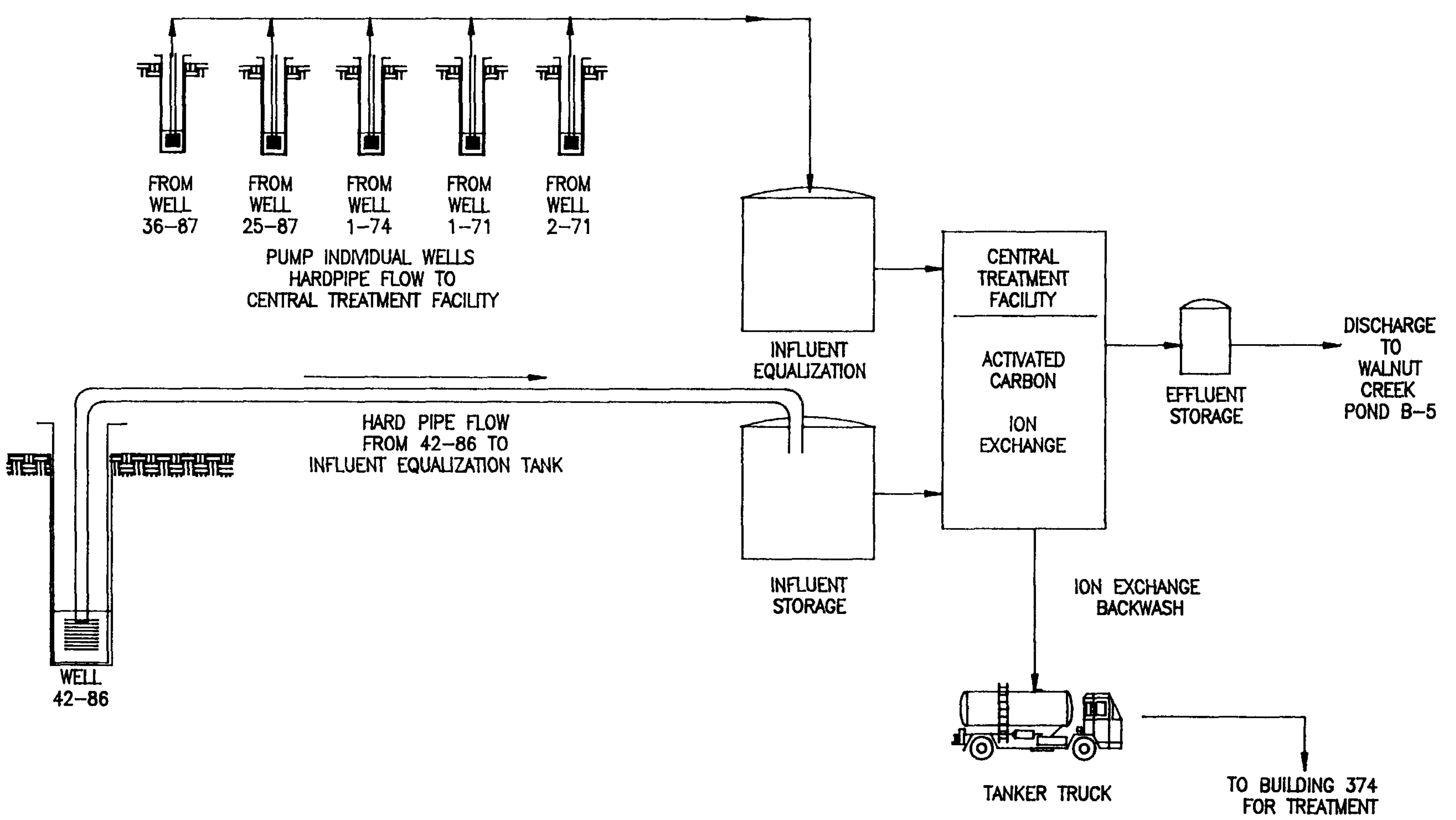

FIGURE 4-6
GROUND-WATER COLLECTION, STORAGE, AND TREATMENT PROCESS FLOW DIAGRAM - ALTERNATIVE 1

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Exterior to Building

Piping

Associated pumps gages and valves

Interior to Building

Influent and effluent equalization tanks

Parallel system equipment

GAC equipment

Ion exchange system equipment

Decarbonator

Sump pump

Associated pumps piping gages and valves

Support equipment for treatment units including an acid supply tank and feed system for the ion exchange process

All tanks and treatment units will be provided with secondary containment and all buried pipes will be double walled to comply with 6 CCR 1007 3 and 40 CFR 264 183

When treatment is initiated water will be pumped from each of the equalization tanks through a series of roughing filters to remove suspended solids The feed water from the five low yield wells (36 87 25 87 1 71 2 71 and 1 74) and well 42 86 will be treated separately in parallel carbon systems each consisting of two granular activated carbon vessels arranged in series for the treatment of organic contaminants Flow rate through the carbon units will be approximately 10 gpm and 20 gpm for the low yield well water and well 42 86 respectively (20 gpm is a reasonable sustained steady state flow for well 42 86) Each carbon unit will be approximately five feet in diameter and 87 inches high and contain 2 000 pounds of carbon At a flow of 10 gpm and 20 gpm the hydraulic loading rate to each column will be approximately 0 5 gpm/ft^2 and 1 0 gpm/ft^2 respectively To completely utilize the carbon a second unit will be placed in series allowing the lead column to become fully exhausted before regeneration while the second (polishing) column ensures effluent quality Periodic samples will be taken from the effluent of each unit and when the lead unit effluent exceeds chemical specific ARARs for organic contaminants the lead carbon column will be removed and the second column will become the lead column A replacement carbon unit will be placed in service to act as the polishing unit The carbon column with the exhausted carbon will then be shipped to an off site location for regeneration Carbon usage rates have been estimated at 1 pound/1 000 gallons treated for the combined flow of the low yield wells and 0 5 pounds/1000 gallons treated for well 42 86 This translates to 5 240 pounds of carbon per year per flow stream based on continuous operation At these usage rates six additional 2 000 pound units will be required every year

The low yield well water will be subjected to ion exchange treatment for the reduction of total dissolved solids and manganese Two ion exchange units will be arranged in parallel One unit will always be in service while the other is being regenerated The weak cation exchange unit will remove bicarbonate alkalinity and in so doing will reduce the dissolved solids concentration and produce carbonic acid After ion exchange treatment this 10 gpm flow will be combined with the flow from well 42 86 Flow from well 42 86 will not require treatment for inorganic contaminants Sufficient reduction of inorganic contaminants from the treatment of the low yield well water will be realized so that a blend in both flows will meet discharge limits for chemical specific ARARs After the flows have been blended they will undergo decarbonation to remove carbonic acid The flow will undergo decarbonation after blending to avoid an additional pH adjustment process before discharge The decarbonator is an air stripper that converts carbonic acid to carbon dioxide for release to the atmosphere There will be no release of volatile organics through the decarbonator

The ion exchange resin will require periodic regeneration with hydrochloric acid It is anticipated that treated effluent will be used as the water supply for regeneration of the ion exchange resin The backwash regeneration volume will be approximately two percent of the treated flow for each regeneration cycle Calculations indicate that the ion exchange unit will require regeneration every 16 hours producing approximately 200 gallons of waste regenerant Regeneration wastes will be stored in a prefabricated HDPE tank and periodically transported via tanker truck to the Building 374 process waste treatment system

As water is treated it will enter an effluent equalization tank that will provide approximately 12 hours of detention time The equalization tank will provide approximately 21 000 gallons of effluent storage for ion exchange regeneration effluent sampling and storage during system maintenance or down time Water will be discharged continuously at 30 gpm from the equalization tank to a buried effluent pipeline The effluent pipeline will follow the course of the Central Avenue Ditch (see Figure 4 4) and resurface at a point approximately 200 feet east of well 36 87 Water will be conveyed via pipeline to prevent infiltration of treated water into the alluvium in the East Trenches Area After resurfacing the treated water will be conveyed along the Central Avenue Ditch for approximately 1 400 feet where it will enter a rock lined channel and eventually discharge to South Walnut Creek and Pond B 5

4 4 1 2 Effectiveness

It is uncertain how effective the ground water collection system proposed in this alternative will be in containing contaminated ground water from Operable Unit 2 The true extent of ground water contamination is not completely understood and will not be until the Phase II remedial investigation is completed However pumping these wells will remove a significant mass of contamination from the ground water at Operable Unit 2

The centrally located treatment facility will remove both the organic and inorganic contaminants to below the chemical specific ARARs given in Section 3 3 1 Location specific ARARs are discussed in Section 3 3 2

Worker safety precautions will be required during construction and set up of this alternative because of the potential for encountering contaminated surface soil Influent equalization tanks will be totally enclosed to prevent worker exposure to VOCs The tanks will be equipped with vents that will exit the treatment building through the roof Vapor phase carbon adsorption units will be provided on each vent to prevent the release of VOCs to the environment Nearby communities will not experience any safety concerns from the construction or operation of this remedial action alternative because water will be collected by using a totally enclosed system Wells will be capped and equalization tanks will be vented through activated carbon units Treated water will be monitored at the effluent equalization tank and at the Pond B 5 discharge point to ensure contaminants are within regulatory guidelines

4 4 1 3 Implementability

Selective pumping of monitoring wells at Operable Unit 2 is expected to be highly effective in collecting contaminated ground water Collection of contaminated ground water through the pumping of wells is a proven technology having been used successfully at many sites under similar conditions The useful life of this alternative is expected to be as long as the interim action is necessary Collection of contaminated ground water through the pumping of select wells is consistent with the objectives of the IM/IRA and will be consistent with long term remedial goals as well

Operation and maintenance requirements are small for this alternative Common centrifugal or air actuated submersible pumps will be used Automatic liquid level controllers switch on a submersible pump in the well whenever there is sufficient water present If long periods of non pumpage are observed water levels in the wells will be investigated to determine if the pumps have failed

Action specific ARARs pertinent to surface discharge of treated water into the Walnut Creek Drainage are the relevant and appropriate requirements under RCRA for the storage and treatment of hazardous waste in containers and tanks prior to surface discharge

The design operation and maintenance of the treatment facility will meet chemical specific ARARs identified for the contaminants of concern and action specific ARARs related to the surface discharge of the treatment system effluent A complete action specific ARARs analysis for treatment operations is given in Table 3 3

Highlights of these action specific ARARs are listed below

Applicable federally approved state water quality standards must be complied with for discharges to surface waters of the state These standards may be in addition to or more stringent than other Federal standards under the Clean Water Act

General requirements for treatment and storage of RCRA hazardous waste in tanks are relevant and appropriate

Implementation of this alternative involves only routine construction and equipment set up procedures Construction of a treatment building and excavation and installation of the buried piping will be the most time consuming activities under this alternative however building construction should proceed rapidly with the use of a prefabricated steel structure All tankage will be steel and can be installed quickly Secondary containment for all tanks and treatment units will be constructed of concrete within the treatment building Treatment units are modular and can be operational within 2 weeks of delivery Well pumping will proceed immediately after the treatment plant is constructed

4 4 1 4 Costs

Estimated capital and operating costs for this alternative are summarized in Table 4 3 The estimated capital cost is $570 600 and the annual operation and maintenance cost is $569 400

TABLE 4 3

ESTIMATED COSTS FOR ALTERNATIVE 1

ITEM		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
A	GROUND WATER COLLECTION		
	Soil Disposal[1]	8 100	
	Redrill Existing Wells	7 500	
	New Wells with Pumps	9 000	
	Pipe Installation Excavation	90 750	
	Electrical Installation	33 750	
	Operation and Maintenance[2]		67 000
	Pump Replacement		9 000
B	GROUND WATER TREATMENT		
	Building	52 000	
	Treatment Units	82 300	
	Parking Area	4 300	
	Electrical/Mechanical[3]	32 900	
	Instrumentation	1 500	
	Influent/Effluent Tanks		28 800
	Activated Carbon		77 100
	Ion Exchange Regeneration		1 700
	Power[4]		12 000
	Operation and Maintenance[5]		133 200
	Monitoring and Analysis[6]		145 600
C	DISCHARGE CONTROL STRUCTURE		
	Channel Construction	85 500	
	Subtotal	407 600	474 400
D	ENGINEERING AND CONTINGENCY		
	Design at 15%	61 100	
	Construction Management at 5%	20 400	
	Contingency at 20%	81 500	95 000
	TOTAL	570 600	569 400

effl ent and/o Pond B 5 d charge at $350/ ample for ola le o gan c A ma ha

4 4 2 Alternative 2. Collect Ground Water from French Drains, Treatment, Discharge Treated Water into South Walnut Creek at Pond B 5

4 4 2 1 Description

This alternative involves the construction of three french drains at the locations shown on Figure 4 7 The drains are located downgradient of areas of known contaminated ground water The drains will be keyed into solid bedrock (hydraulic conductivity less than or equal to 10^{6} cm/sec) in order to fully penetrate the surficial material For each of the drains a PVC drainage pipe will direct flow under gravity to a concrete collection sump (additional sumps may be required in areas where the bedrock surface undulates) Each sump will be equipped with a submersible sump pump to deliver water from the drain to the influent storage tank The downstream face of the french drain will be covered with a synthetic membrane to limit flow from the clean side of the trench (Figure 4 8) The inclusion of the downstream synthetic membrane coupled with the continuity of the drain is expected to provide positive cutoff of the ground water The approximate lengths depths and expected ground water production for each of the three areas are shown on Table 4 4 The chemical characteristics of the combined flows are shown in Table 4 5 The collected ground water will be metered and conveyed to the treatment plant via buried pipeline The expected combined yield of the french drain system is 6 7 gpm or 9 650 gallons per 24 hour period As water accumulates in the collection sumps it will be pumped to an influent equalization tank When treatment is initiated water will be pumped from the equalization tank through a series of roughing filters to remove suspended solids The water will then be pumped into two granular activated carbon vessels arranged in series for the treatment of organic contaminants Each carbon vessel will approximately be five feet in diameter and 87 inches high and contain 2 000 pounds of carbon Carbon usage rates have been estimated at 0 75 pounds per 1 000 gallons treated In one year this translates to 2 640 pounds of carbon Therefore one additional vessel will be required during the year The hydraulic loading rate on the carbon units will be less than 0 5 gpm/ft^2

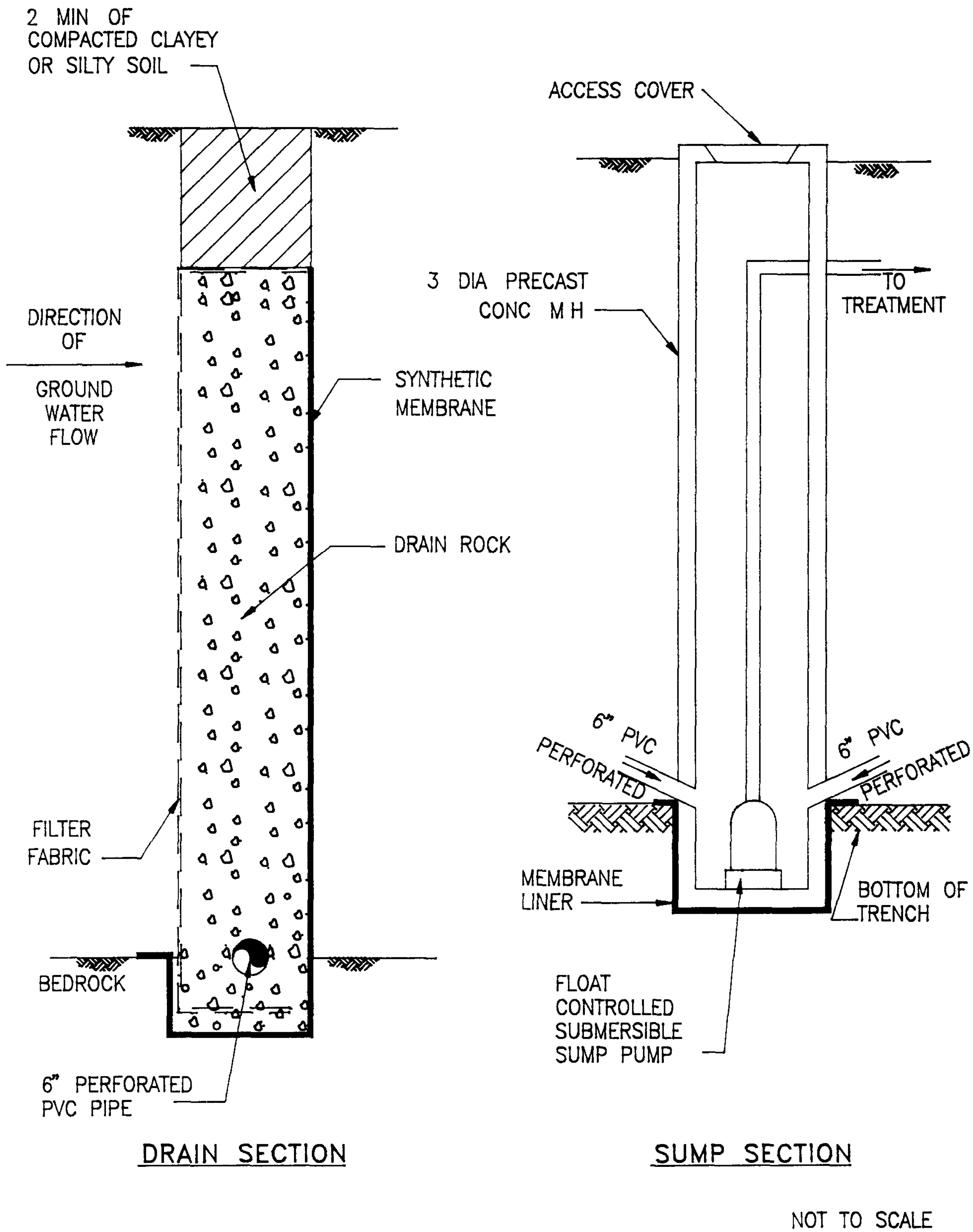

FIGURE 4-8
FRENCH DRAIN SECTION

r37010.pj-110889

TABLE 4 4 SUMMARY OF FRENCH DRAIN PERFORMANCE FEATURES

Area	Subsurface Material	Length (ft)	Depth (ft)	Conductivity[1] (cm/s)	Sat'd Thickness (ft)	Flow rate[2] (gpm)
903 Pad	Colluvium	920	15	$1\text{x}10^{4}$	2	0 18
Mound	Rocky Flats Alluvium	200	20	$1\text{x}10^{4}$	6 5	0 22
East Trench	Rocky Flats Alluvium	920	25	$1\text{x}10^{2}$	5	6 3

Notes

1 903 Pad drain is assumed to traverse only colluvium however the eastern end will traverse a short distance of Rocky Flats Alluvium Therefore the hydraulic conductivity value used is appropriate for gravels in the colluvium (881 Hillside value) although gravels are not believed to be present In addition it is assumed that two feet of saturation will be found along the entire length of the drain whereas data indicate the colluvial soils on the hillside are unsaturated

2 Flow rate is approximately the 60 day average flow rate as predicted by the expression for variable flow under constant drawdown to a trench The constant drawdown was assumed equal to the saturated thickness and the storage coefficient was assumed to be 0 1 Although the flow rate can be expected to continue to decline to steady state the above values are suitable for conceptual design

TABLE 4 5

CHEMICAL CHARACTERISTICS OF COMBINED FLOW FOR ALTERNATIVE 2

	Units	Influent [a] Concentration	Treatment Requirements
ORGANICS			
Chloroform	µg/l	14	5
Trichloroethene	µg/l	149	5
Carbon Tetrachloride	µg/l	970	5
1 1 Dichloroethene	µg/l	<5 [b]	7
Tetrachloroethene	µg/l	680	5
1 1 Dichloroethane	µg/l	<5 [b]	5 (TBC)[c]
METALS			
Aluminum	mg/l	1 274	5 0
Barium	mg/l	0 210	1 0
Chromium	mg/l	0 029	0 05 (hex)
Copper	mg/l	0 022	0 20
Iron	mg/l	0 152	0 3
Manganese	mg/l	0 093	0 05
Nickel	mg/l	0 088	0 20
Selenium	mg/l	0 005	0 01
Uranium (dissolved)	pCi/l	4 6	40 0
Vanadium	mg/l	0 012	0 1
Zinc	mg/l	0 052	2 0

TABLE 4 5
(continued)

CHEMICAL CHARACTERISTICS OF COMBINED
FLOW FOR ALTERNATIVE 2

	Units	Influent [a] Concentration	Treatment Requirements
MAJOR IONS			
Calcium	mg/l	110	
Magnesium	mg/l	13	
Potassium	mg/l	1	
Sodium	mg/l	25	
Chloride	mg/l	51	250
Nitrate & Nitrite (as N)	mg/l	6	10
Sulfate	mg/l	30	250
Bicarbonate	mg/l	244	
Total Dissolved Solids	mg/l	440	400 or 1 25 X background whichever is least restrictive

a Based on a flow weighted average of alluvial ground water quality upgradient of the french drains at the 903 Pad (wells 15 87 1 71 2 71 Q = 0 18 gpm) Mound (wells 1 74 19 87 43 86 Q = 0 22 gpm) and East Trenches (wells 3 74 35 87 42 86 22 74 24 87 Q = 6 3 gpm) areas Averages computed from the 1987 and 1988 database except organics Organic compound concentrations determined from first and second quarter 1989 data Antimony arsenic beryllium cadmium cobalt lead mercury molybdenum vanadium silver and thallium and TCL volatiles not listed were below detection limits

b Detectable concentrations in some wells however blend should have non detectable concentrations

c TBC To be considered See Section 3

After GAC treatment the water will enter one six cubic foot weak acid cation exchange column The hydraulic loading rate for the column will be approximately 2 2 gpm/ft^3 (three cubic feet of resin) One additional identical unit will be arranged in parallel to handle the flow when the operating unit is being regenerated Calculations indicate that the ion exchange unit can operate for 21 hours before requiring regeneration Regenerant waste volume will be approximately 200 gallons every 21 hours of operation for a total of 1 600 gallons per week Waste regenerant will be stored at the treatment plant and periodically transported via tanker truck to the Building 374 process waste treatment system

After treatment for organic and inorganic contaminants the water will require decarbonation to remove the carbonic acid produced during ion exchange The decarbonator will convert carbonic acid to carbon dioxide for release to the atmosphere

Effluent from the decarbonator will be stored in prefabricated equalization tank that will provide approximately 52 hours of detention time The equalization tank will provide approximately 21 000 gallons of effluent storage for ion exchange regeneration effluent sampling and storage during system maintenance or down time Water will discharge continuously at 6 7 gpm from the equalization tank to a buried effluent pipeline The effluent pipeline will follow the course of the Central Avenue Ditch (see Figure 4 7) and resurface at a point approximately 200 feet east of well 36 87 Water will be conveyed via pipeline to prevent infiltration of treated water into the alluvium in the East Trenches Area After resurfacing the treated water will be conveyed along the Central Avenue Ditch for approximately 1 400 feet where it will enter a rock lined channel and eventually discharge to South Walnut Creek and Pond B 5

4 4 2 2 Effectiveness

The proposed interim action is intended to collect ground water at Operable Unit 2 in french drains downgradient of areas of known contamination French drains can be highly effective in containing and collecting ground water When the drain is keyed into a low permeability base and backed up with a downstream low permeability membrane a french drain is the most positive method of ground water control available However french drain control of contaminated ground water migration at the Operable Unit 2 sites will only be partially effective The reasons for this are as follows

The drain at the 903 Pad Area is in an area where the extent of contaminated ground water and saturated material is poorly defined

The drain at the Mound Area is also in an area where the extent of contamination is poorly defined

The proposed treatment system will remove both the organic and inorganic contaminants from ground water collected from Operable Unit 2 to levels below the chemical specific ARARs given in Section 3 3 1 Location specific ARARs are discussed in Section 3 3 2

Worker safety precautions will be required during construction of this alternative because of the potential for encountering contaminated soil or water in the excavation Influent equalization tanks will be totally enclosed to prevent worker exposure to VOCs The tanks will be equipped with vents that will exit the treatment building through the roof Vapor phase carbon adsorption units will be provided on each vent to prevent the release of VOCs to the environment Nearby communities should realize no safety concerns from the construction or operation of this remedial action alternative Treated water will be monitored at the effluent equalization tanks and at the Pond B 5 discharge point to ensure contaminants are within regulatory guidelines

4 4 2 3 Implementability

The useful life of the french drain systems is expected to be as long s the interim action is required The drain design provides for clean outs at regular distances along its length which can be used for both mechanical and chemical cleaning if required Replacement of the pumps in the sumps should be expected as part of routine operation

Operation and maintenance requirements are small for a french drain Flow to the sump is by gravity Liquid level controllers switch on a submersible pump in the central sump whenever there is sufficient water present Pumping records will be reviewed regularly to ensure that the system is operating

Action specific ARARs relating to soil excavation which may be pertinent to this alternative include the requirements under RCRA that address the storage of RCRA wastes in waste piles and restrictions on the land disposal of solvent containing wastes that exceed treatment based standards for those constituents Soils removed during excavation of the french drain will likely contain hazardous constituents and must be handled as RCRA hazardous waste Of particular relevance to the handling and storage of the soil is the RCRA requirement of diverting run on away from waste piles preventing wind dispersal of wastes and collecting free liquids or leachate for treatment as a hazardous waste RCRA requirements for the storage of soil in containers (roll off boxes or drums) would also be relevant and appropriate if containers are used for storage With respect to RCRA restrictions on the land disposal of solvent containing wastes soils may not be disposed on site or off site unless they have been analyzed and found to contain levels of contamination below threshold limits (treatment based standards) for those contaminants or treated to Best Demonstrated Available Technology (BDAT) standards

Implementation of this alternative involves only routine construction procedures Construction of the drains can be completed in a period of approximately three months after design The system will be operational upon completion of the treatment facility

4 4 2 4 Costs

Estimated capital and operating costs for this alternative are summarized in Table 4 6 The estimated capital cost is $3 940 200 and the annual operation and maintenance cost is $509 700

TABLE 4 6

ESTIMATED COSTS FOR ALTERNATIVE 2

ITEM		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
A	GROUND WATER COLLECTION		
	Soil Disposal[1]	2 121 100	
	French Drain/Sumps/Pumps	347 200	
	Pipe Installation Excavation	80 300	
	Electrical Installation	30 000	
	Operation and Maintenance[2]		67 000
	Pump Replacement		9 000
B	GROUND WATER TREATMENT		
	Building	52 000	
	Treatment Units	66 100	
	Parking Area	4 300	
	Electrical/Mechanical[3]	26 400	
	Instrumentation	1 500	
	Influent/Effluent Tanks		17 800
	Activated Carbon		38 400
	Ion Exchange Regeneration		1 700
	Power[4]		12 000
	Operation and Maintenance[5]		133 200
	Monitoring[6]		145 600
C	DISCHARGE CONTROL STRUCTURES		
	Channel Construction	85 500	
	Subtotal	2 814 400	424 700
D	ENGINEERING AND CONTINGENCY		
	Design at 15%	422 200	
	Construction Management at 5%	140 700	
	Contingency at 20%	562 900	85 000
	TOTAL	3 940 200	509 700

TABLE 4 6
(Continued)

ESTIMATED COSTS FOR ALTERNATIVE 2

PRESENT WORTH.

Present Worth Factor (PWF)	=	9 427 (30 years 10%1 for annual costs)
$509 700/year x 9 427	=	$ 4 804 900
1989 Capital Cost	=	$ 3,940,200
		$ 8 745 100

1 To be conservative in cost estimating it is assumed that excavated soils are mixed waste requiring disposal at the Nevada Test Site at a unit cost for transportation and disposal of $ 450/cubic yard If testing indicates soils are not contaminated use as backfill or for other purposes will be unrestricted

2 Operation and maintenance for ground water collection is based on one person per shift three shifts per day and one hour/shift at $61/hr

3 Electrical and mechanical costs estimated at 40% of treatment units capital cost

4 Power estimates are based on six 1/2 HP sump pumps operated continuously five 2 HP process pumps operated 8 hours per day and 16 64 kilowatts for lighting and heating all at $0 07 per KW HR

5 Operation and maintenance for ground water treatment is based on one operator per shift three shifts per day for 2 hours per shift seven days per week

6 Monitoring and analytical costs are based on eight samples per week of influent effluent and/or Pond B 5 discharge at $350/sample for volatile organics Assumes that treatment plant operator will collect the samples and analyze for conductivity (TDS) and manganese

4 4 3 Alternative 3. Collect Ground Water from Well Arrays, Treatment, Discharge Treated Water into Walnut Creek Drainage at Pond B 5

4 4 3 1 Description

Alternative 3 consists of the interception of contaminated alluvial ground water flow from the three Operable Unit 2 sites using a line of pumping wells (well arrays) at each of the areas The line of pumping wells will be constructed in the same locations as the french drains (Figure 4 7) The approximate depths number spacing and expected ground water production of the wells are shown on Table 4 7 It is estimated that the well array can provide a 20 gpm sustained flow for treatment Chemical characteristics of the combined flow from each well array is the same as that for the french drain system (Table 4 5) Water collected from the well array will be piped directly via buried pipeline to an influent equalization tank and treated in the new treatment plant Flow from each array will be metered Effluent from the treatment plant will be discharged into South Walnut Creek at Pond B 5

The wells must fully penetrate the alluvium and weathered bedrock to a depth where the permeability of the bedrock has a hydraulic conductivity of less than 10^{6} cm/sec The wells will be cased with 6 inch diameter casing and will be pumped on a continuous basis using liquid level controlled submersible pumps (air actuated or standard centrifugal)

The treatment process will operate continuously and will begin by pumping stored influent through roughing filters to remove suspended solids Water will then be pumped into two activated carbon units arranged in series The hydraulic loading rate on each carbon unit will be approximately 1 0 gpm/ft^2 Each carbon vessel will be five feet in diameter and 87 inches high and contain 2 000 pounds of carbon The carbon usage rate for this water is estimated at 0 75 pounds per 1 000 gallons treated In one year this translates to 7 885 pounds of carbon Therefore four additional vessels will be required during the year

TABLE 4 7 SUMMARY OF PERFORMANCE OF LINES OF PUMPING WELLS

Area	Conductivity[1] (cm/s)	Sat'd Thickness (ft)	Well Depth (ft)	Number Of Wells[2]	Spacing (ft)	Length Of Control (ft)	Draw down at 1/2 Spacing[3] (ft)	Flow from all Wells[4] (gpm)
903 Pad	1×10^{4}	2	15	20	48	920	0 1	0 12
Mound	1×10^{4}	5	20	4	67	200	0 4	0 25
East Trench	1×10^{2}	6 5	25	20	103	930	1 1	30

Notes

1 Hydraulic properties are justified on Tables 4 1 and 4 4

2 The number of wells and spacings were estimated by first calculating the average 30 day flow to a single constant drawdown variable flow well and then predicting drawdowns after 45 days using the average flow as a constant flow in the Theis equation Storage coefficient was always assumed equal to 0 1 The length of control was divided by the spacing to yield the number of wells needed Then an additional well was added so that there will be a production well at each end of the control length

3 The drawdown at the 1/2 spacing (24 feet for the 903 Pad wells) was calculated using the 30 day average flow after 45 days of pumping

4 The flow from all wells is the 30 day average flow multiplied by the number of wells needed to provide the length of control without regard to interference effects Therefore these flow rates are considered conservative and are appropriate for conceptual design purposes

After organic treatment the flow will be split evenly between two weak acid cation exchange units arranged in parallel for the treatment of inorganic contaminants At a loading rate of 3 3 gpm/ft^3 of resin each ion exchange unit will require regeneration every 15 hours The expected waste regenerant volume will be approximately 400 gallons per 15 hour period or 4 480 gallons per week Two identical units will be arranged in parallel to treat the design flow as the other two units are being regenerated The waste regenerant will be stored at the treatment facility and periodically transported via tanker truck to the Building 374 process waste treatment facility

Effluent from the ion exchange units will undergo decarbonation to remove carbonic acid produced during ion exchange Effluent from the decarbonator will be stored in prefabricated equalization tank that will provide approximately 18 hours of detention time The equalization tank will provide approximately 21 000 gallons of effluent storage for ion exchange regeneration effluent sampling and storage during system maintenance or down time Water will discharge continuously at 20 gpm from the equalization tank to a buried effluent pipeline The effluent pipeline will follow the course of the Central Avenue Ditch (see Figure 4 7) and resurface at a point approximately 200 feet east of well 36 87 Water will be conveyed via pipeline to prevent infiltration of treated water into the alluvium in the East Trenches Area After resurfacing the treated water will be conveyed along the Central Avenue Ditch for approximately 1 400 feet where it will enter a rock lined channel and eventually discharge to South Walnut Creek and Pond B 5

4 4 3 2 Effectiveness

Collection and treatment of contaminated ground water at Operable Unit 2 using well arrays will to an uncertain extent contain and remove the contaminants currently released downgradient in this medium Because of subsurface heterogeneities complete cutoff of ground water flow by overlapping cones of depression from the dewatering wells is not absolutely assured Furthermore control of contaminated ground water at any of the three areas using well arrays will have limited effectiveness for the following additional reasons

A well array at the 903 Pad Area is in an area where the extent of contaminated ground water and saturated material is poorly defined

A well array at the Mound Area is also in an area where the extent of contamination is poorly defined

Standard worker safety precautions will be required during installation of the well array and trenching for the collection manifold because of the potential for encountering contaminated soils or water in the drill holes and excavations Influent equalization tanks will be totally enclosed to prevent worker exposure to VOCs The tanks will be equipped with vents that will exit the treatment building through the roof Vapor phase carbon adsorption units will be provided on each vent to prevent the release of VOCs to the environment Nearby communities should realize no safety concerns from the construction or operation of this remedial action alternative Treated water will be monitored at the equalization tank and at the Pond B 5 discharge point to ensure contaminants are within regulatory guidelines

4 4 3 3 Implementability

Pumping of well arrays at Operable Unit 2 is expected to be highly effective in collecting contaminated ground water Collection of contaminated ground water through the pumping of wells is a proven technology having been used successfully at many sites under similar conditions The useful life of this alternative is expected to be as long as the interim action is necessary or until full remedial action is implemented Collection of contaminated ground water by recovery wells is consistent with the objectives of the IM/IRA and will be consistent with long term remedial goals as well

Operation and maintenance requirements are small for this alternative Common centrifugal or air actuated submersible pumps will be used Automatic liquid level controllers switch on a submersible pump in the well whenever there is sufficient water present If long periods of non pumpage are observed water levels in the wells will be investigated to determine if the pumps have failed

Action specific ARARs pertinent to surface discharge of treated water into the Walnut Creek Drainage are the relevant and appropriate requirements under RCRA for the storage and treatment of hazardous waste in containers and tanks prior to surface discharge

The design operation and maintenance of the treatment facility will meet chemical specific ARARs identified for the contaminants of concern and action specific ARARs related to the surface discharge of the treatment system effluent A complete ARARs analysis for treatment operations is given in Table 3 3

Highlights of these action specific ARARs are listed below

- Applicable federally approved state water quality standards must be complied with for discharges to surface waters of the state These standards may be in addition to or more stringent than other Federal standards under the Clean Water Act

- General requirements for treatment and storage of RCRA hazardous waste in tanks are relevant and appropriate

Implementation of this alternative involves the installation of 44 wells and equipment set up procedures Construction of a treatment building and excavation and installation of the buried piping can be conducted concurrently with well drilling Building construction should proceed rapidly with the use of a prefabricated steel structure All tankage will be steel and can be installed quickly Secondary containment for all tanks and treatment units will be constructed of concrete within the treatment building Treatment units are modular and can be operational within 2 weeks of delivery Well pumping will proceed immediately after the treatment plant is constructed

4 4 3 4 Costs

Estimated capital and operating costs for Alternative 3 are summarized in Table 4 8 The estimated capital cost is $737 500 and the annual operation and maintenance cost is $606 700

TABLE 4 8

ESTIMATED COSTS FOR ALTERNATIVE 3

ITEM		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
A	GROUND WATER COLLECTION		
	Soil Disposal[1]	54 000	
	Well Arrays/Pumps	106 800	
	Pipe Installation Excavation	90 800	
	Electrical Installation	33 800	
	Operation and Maintenance[2]		67 000
	Pump Replacement		66 000
B	GROUND WATER TREATMENT		
	Building	52 000	
	Treatment Units	70 100	
	Parking Area	4 300	
	Electrical/Mechanical[3]	28 000	
	Instrumentation	1 500	
	Influent/Effluent Tanks		17 800
	Activated Carbon		51 600
	Ion Exchange Regeneration		3 700
	Power[4]		20 700
	Operation and Maintenance[5]		133 200
	Monitoring and Analysis[6]		145 600
C	DISCHARGE CONTROL STRUCTURE		
	Channel Construction	85 500	
	Subtotal	526 800	505 600
D	ENGINEERING AND CONTINGENCY		
	Design at 15%	79 000	
	Construction Management at 5%	26 300	
	Contingency at 20%	105 400	101 100
	TOTAL	737 500	606 700

TABLE 4-8
(Continued)

ESTIMATED COSTS FOR ALTERNATIVE 3

PRESENT WORTH.

Present Worth Factor (PWF)	=	9 427 (30 years 10%ı for annual costs)
$606 700/year x 9 427	=	$ 5 719 400
1989 Capital Cost	=	$ 737,500
		$ 6 456 900

1 To be conservatıve ın cost estımatıng ıt ıs assumed that excavated soıls are mıxed waste requırıng dısposal at the Nevada Test Sıte at a unıt cost for transportatıon and dısposal of $ 450/cubıc yard If testıng ındıcates soıls are not contamınated use as backfıll or for other purposes wıll be unrestrıcted

2 Operatıon and maıntenance for ground water collectıon ıs based on one person per shıft three shıfts per day and one hour/shıft at $61/hr

3 Electrıcal and mechanıcal costs estımated at 40% of treatment unıts capıtal cost

4 Power estımates are based on 44 1/2 HP well pumps operated contınuously fıve 2 HP process pumps operated contınuously and 16 64 kılowatts for lıghtıng and heatıng all at $0 07 KW HR

5 Operatıon and maıntenance for ground water treatment ıs based on one operator per shıft for three shıfts per day at 2 hours per shıft seven days per week at $61/hour

6 Monıtorıng and analytıcal costs are based on eıght samples per week of ınfluent effluent and/or Pond B 5 dıscharge at $350/sample for volatıle organıcs Assumes that treatment plant operator wıll collect the samples and analyze for conductıvıty (TDS) and manganese

4 4 4 Cost Summary

Table 4 9 provides a cost summary for each of the alternatives Alternative 1 is the least capital intensive alternative however Alternative 2 will require the smallest annual expenditure for operation and maintenance Alternative 2 calls for treating the least amount of ground water On a present worth basis Alternative 1 is the least expensive alternative

TABLE 4 9
SUMMARY OF ALTERNATIVE COSTS

Capital Cost Worksheet (Dollars)

COMPONENT DESCRIPTION	Alternative Number 1	2	3
A **GROUND WATER COLLECTION**			
Redrill Existing Wells	$ 7 500	$	$
Existing Wells with Pumps	9 000		
French drain/sumps/pumps		347 200	
Well array/pumps			106 800
Pipe Installation Excavation	90 750	80 300	90 800
Electrical Installation	33 750	30 000	33 800
Soil Disposal	8 100	2 121 100	54 000
B **GROUND WATER TREATMENT**			
Building	52 000	52 000	52 000
Treatment Units	82 300	66 100	70 100
Parking Area	4 300	4 300	4 300
Electrical/Mechanical	32 900	26 400	28 000
Instrumentation	1 500	1 500	1 500
C **DISCHARGE CONTROL STRUCTURE**			
Channel Construction	85 500	85 500	85 500
Subtotal	407 600	2 814 400	526 800
Design at 15%	61 100	422 200	79 000
Construction Management at 5%	20 400	140 700	26 300
Contingency at 20%	81 500	562 900	105 400
TOTAL CAPITAL COST	$ 570 600	$ 3 940 200	$ 737 500

TABLE 4 9
(Continued)

SUMMARY OF ALTERNATIVE COSTS

Annual Cost Component Worksheet
(Dollars per Year)

COMPONENT DESCRIPTION	Alternative Number 1	2	3
A <u>GROUND WATER COLLECTION</u>			
Operation and Maintenance	$ 67 000	$ 67 000	$ 67 000
Pump Replacement	9 000	9 000	66 000
B <u>GROUND WATER TREATMENT</u>			
Influent Effluent Tanks	28 800	17 800	17 800
Activated Carbon	77 100	38 400	51 600
Ion Exchange Regenerant	1 700	1700	3 700
Power	12 000	12 000	20 700
Operation and Maintenance	133 200	133 200	133 200
Monitoring and Analysis	145 600	145 600	145 600
SUBTOTAL	474 400	424 700	505 600
Contingency @ 20%	95 000	85 000	101 100
TOTAL ANNUAL COST	$ 569 400	$ 509 700	$ 606 700
Annual Costs	$ 569 400	$ 509 700	$ 606 700
Annual Costs X PWF*	5 367 700	4 804 900	5 719 400
Capital Cost	570 600	3 940 200	737 500
Present Worth	$ 5 938 300	$ 8 745 100	$ 6 456 900

* Present Worth Factor = 9 427 (for annual operating costs)

SECTION 5 0

COMPARATIVE ANALYSIS

This section summarizes the three screened alternatives and presents a tabular comparison of them (Table 5 1) A recommendation is made for appropriate remedial action using the comparative analysis

The following three alternatives were evaluated for the Operable Unit 2 IM/IRA

1 Selective pumping of existing high contamination/high yield monitoring wells treat water continuously for organic and inorganic contaminants at a centrally located treatment facility discharge treated water to South Walnut Creek at Pond B 5

2 Collection of contaminated ground water using a french drain store collected ground water in on site tanks and treat water on a batch basis for organic and inorganic contaminants at a centrally located treatment facility discharge treated water to South Walnut Creek at Pond B 5

3 Collection of contaminated ground water using a line of downgradient wells (well array) treat water continuously for organic and inorganic contaminants at a centrally located treatment facility discharge treated water to South Walnut Creek at Pond B 5

Discharge of collected ground water is identical for all three alternatives and thus will not be a factor in the comparative analysis The treatment system will effectively remove both the organic and inorganic contaminants in the ground water to below the chemical specific ARARs Discharge of the treated water into South Walnut Creek allows for the water to be combined with Pond B 5 water before final discharge off site in accordance with the Rocky Flats Plant NPDES permit

Alternative 1 is simple easy to implement and results in effective collection of contaminated ground water The pumping of existing alluvial and bedrock wells throughout Operable Unit 2 and subsequent treatment of the ground water at a new treatment plant utilizes proven technologies There are no site conditions that will hinder the implementation of this alternative This alternative mitigates contaminated ground water migration by

TABLE 5 1

SUMMARY OF ALTERNATIVES

Alternative and Present Worth	Implementability	Effectiveness	Comments
1 Selective pumping of existing wells treatment and discharge $ 5 938 300	This alternative relies on proven technologies for collection and treatment of ground water There are no site conditions that hinder implementability	Pumping these wells will remove a significant mass of contaminant from the ground water However it is uncertain how effective this alternative will be in containing contaminated ground water given that the extent of ground water contamination is poorly defined	Complies with action and location specific ARARs and meets or exceeds chemical specific ARARs for contaminants
2 French drains treatment and discharge $ 8 745 100	This alternative relies on proven technologies for collection and treatment of ground water Significant time and capital is required for implementation There are moderate operation and maintenance requirements Soils removed during excavation of trench will likely contain hazardous constituents	French drains will only be partially effective because 1) drain at East Trenches cannot be sealed completely due to sandstone subcrops 2) soils at 903 Pad are mostly unsaturated and 3) extent of contamination is poorly defined at all areas making placement of drains difficult	Must comply with action specific ARARs for soil removal and storage
3 Well array treatment and discharge $ 6 456 900	This alternative relies on proven technologies for collection and treatment of ground water Significant time is required for implementation Soils removed during excavation of trenches for collection manifold will likely contain hazardous constituents	Complete cutoff of ground water flows by overlapping cones of depression from dewatering wells is not assured because of potential unquantified heterogenities In addition 1) well array at East Trenches is underlain by sandstone subcrops (poor bottom seal) 2) a well array at the 903 Pad Area is in soils that are mostly unsaturated and significant contamination occurs in bedrock and 3) effectiveness of well array at the Mound Area is uncertain because extent of contamination is poorly defined	Must comply with action specific ARARs for soil removal and storage

withdrawing both alluvial and bedrock ground water containing high levels of VOCs from wells with high sustained yields i e extracting ground water from water bearing zones that have the greatest contaminant mass flux Pumping these wells will be an effective interim remedial action because they will remove a significant mass of contaminant from the ground water However it is uncertain how effective the selective well pumping will be in containing the migration of contaminated ground water from Operable Unit 2 because the true extent of contamination is poorly defined

The use of french drains (Alternative 2) or well arrays (Alternative 3) to collect and contain contaminated ground water from Operable Unit 2 will not be considered further for the following reasons

- The extent of ground water contamination is only roughly defined thereby preventing accurate placement of the collection systems in order to effectively contain ground water flows

- The collection system at the 903 Pad Area is also likely to be marginally effective because of the extent of unsaturated soils

- Alternatives 2 and 3 are more costly and require more time to implement than Alternative 1

Determination of the extent of ground water contamination is being addressed in the Phase II RI Plan (in progress)

SECTION 6 0

PROPOSED IM/IRA

Alternative 1 has been chosen as the preferred interim measures/interim remedial action for Operable Unit 2 This alternative involves the collection of ground water from existing alluvial and bedrock monitoring wells located throughout Operable Unit 2 The alternative mitigates contaminated ground water migration by withdrawing ground water containing high levels of VOCs from wells with high sustained yields Ground water in wells 42 86 2 71 36 87BR 25 87BR 1 71 and 1 74 has the greatest contaminant mass flux potential and thus have been selected for pumping These wells will be redrilled to their existing total depth to accommodate new well pumps The ground water will be withdrawn using either centrifugal or air activated pumps The flow from each well will be piped via buried pipeline directly to influent equalization tanks located inside a newly constructed treatment facility building Flow from each well will be metered for the purposes of monitoring the quantity of ground water collected The treatment facility will be located north of the east Plant access road and immediately west of the western boundary of the East Trenches Area (see Figure 4 4) Buried pipelines will be routed around the boundaries of SWMUs to prevent disturbing potentially contaminated soils and exposing personnel to hazardous substances

The flow from wells 1 71 2 71 1 74 25 87BR and 36 87BR will be combined and segregated from the flow of well 42 86 The flows will be segregated because the chemical characteristics of ground water at well 42 86 are such that it will not require treatment for inorganic contaminants Flow from well 42 86 will be pumped via pipeline directly to a dedicated influent equalization tank A separate influent storage tank will be used for the ground water collected from the other wells The ground water will be pumped and treated continuously Influent and effluent equalization tanks will provide limited storage capacity to provide time for maintenance of treatment units Power for the treatment plant and well pumps will be provided by the installation of new electric service from the Plant

The ground water collected will be treated using granular activated carbon (for organics removal) and an ion exchange system (for inorganics removal) A new building will be erected for enclosure of the water treatment system to protect weather or temperature sensitive components Fire protection within the building will be provided by two wall mounted 25 pound dry chemical type fire extinguishers The building and all treatment units are constructed of non combustible materials Other than minimal files and records no combustible materials will be maintained within the building Major components of the treatment system include

Exterior to Building

Piping

Associated pumps gages and valves

Interior to Building

Influent and effluent equalization tanks

Parallel system of filters

GAC equipment

Ion exchange system equipment

Decarbonator

Sump pump

Associated pumps piping gages and valves

Support equipment for treatment units including an acid supply tank and feed system for the ion exchange process

Tanks and treatment units will be equipped with secondary containment Buried piping will be double walled to comply with 6 CCR 1007 3 and 40 CFR 264 193

The ground water will be treated according to the process flow diagram presented in Figure 6 1 When the treatment is initiated water will be pumped from each of the equalization tanks through a series of roughing filters to remove suspended solids The feed water from the low yield wells (36 87 25 87 1 71 2 71 and 1 74) and the high yield well (42 86) will

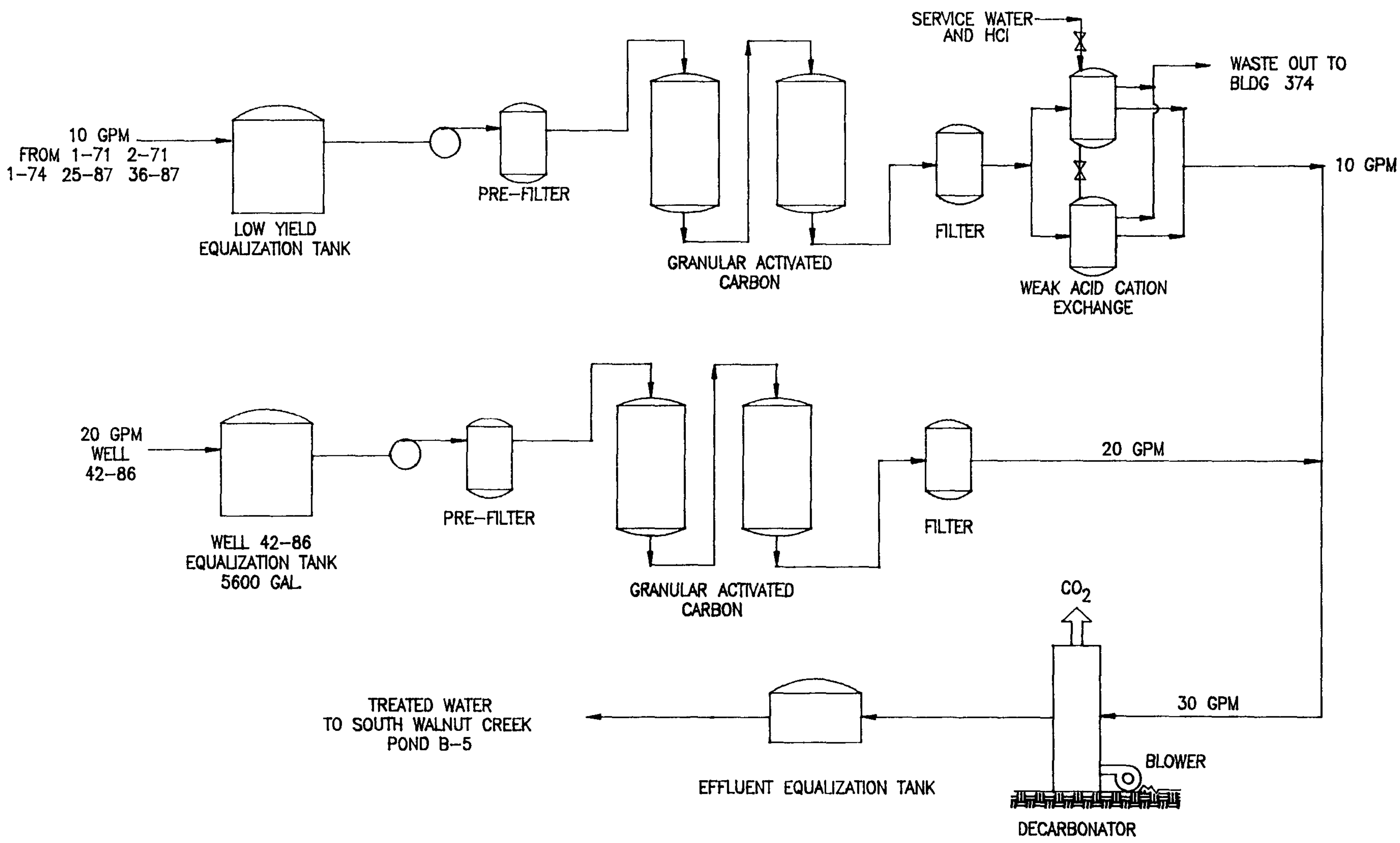

FIGURE 6-1

PREFERRED ALTERNATIVE TREATMENT SYSTEM PROCESS FLOW DIAGRAM

R51001 PJMB-112789

be treated separately in parallel carbon systems each consisting of two granular activated carbon vessels arranged in series for the treatment of organic contaminants Flow through the carbon units will be approximately 10 gpm and 20 gpm for the low yield wells and well 42 86 respectively Each carbon unit is five feet in diameter and 87 inches high and contains 2 000 pounds of carbon At a flow of 10 gpm and 20 gpm the hydraulic loading rate to each column will be approximately 0 5 gpm/ft^2 and 1 0 gpm/ft^2 respectively To completely utilize the carbon a second unit will be placed in series allowing the lead column to become fully exhausted before regeneration while the second (polishing) column ensures effluent quality Periodic samples will be taken from the effluent of each unit and when the lead unit effluent exceeds chemical specific ARARs for organic contaminants the lead carbon column will be removed and replaced by the second column A replacement carbon unit will be placed in service to act as the polishing unit The carbon column with the exhausted carbon will then be shipped to an off site location for regeneration Radionuclides although above estimated background levels are at levels considerably less than the chemical specific ARARs If adsorption of radionuclides renders the carbon a mixed waste spent carbon will be disposed of at the Nevada Test Site (NTS) Otherwise spent carbon will be regenerated

The low yield well water will be subjected to ion exchange treatment for the reduction of total dissolved solids and manganese Two ion exchange units will be arranged in parallel One unit will always be in service while the other is being regenerated The weak acid cation exchange unit will remove bicarbonate alkalinity and in so doing will reduce the dissolved solids concentration and produce carbonic acid After ion exchange treatment this 10 gpm flow will be combined with the flow from well 42 86 Flow from well 42 86 will not require treatment for inorganic contaminants Sufficient reduction of inorganic contaminants from the treatment of the low yield well water will be realized so that a blend of both flows will meet discharge limits for chemical specific ARARs After the flows have been blended they will undergo decarbonation to remove carbonic acid The flow will undergo decarbonation after blending to avoid pH adjustment before discharge The decarbonator is an air stripper that converts carbonic acid to carbon dioxide for release to the atmosphere There will be no release of volatile organics through the decarbonator as they will have been previously removed

The ion exchange resin will require periodic regeneration with hydrochloric acid The regenerant waste volume will be approximately two percent of the flow treated or about 2 000 gallons per week The spent carbon units will be shipped off site as hazardous waste for regeneration It is anticipated that treated effluent will be used as the water supply for regeneration of the ion exchange resin Regeneration wastes will be stored in a prefabricated HDPE tank and periodically transported via tanker truck to the Building 374 process waste treatment system

As water is treated it will enter an effluent equalization tank that will provide approximately 12 hours of detention time The equalization tank will provide approximately 21 000 gallons of effluent storage for ion exchange regeneration effluent sampling and storage during system maintenance or down time Samples will be collected twice per week from the effluent tank In the unlikely event that contaminants are present in the effluent at concentrations above ARARs pumping and discharge will cease until the treatment problem is identified and corrected In this event Pond B 5 will also be sampled to assess whether its contents can be discharged in accordance with the NPDES permit With the exception noted above water will be discharged continuously at 30 gpm from the equalization tank to a buried effluent pipeline The effluent pipeline will follow the course of the Central Avenue Ditch (see Figure 4 4) and resurface at a point approximately 200 feet east of well 36 87 Water will be conveyed via pipeline to prevent infiltration of treated water into the alluvium in the East Trenches Area After resurfacing the treated water will be conveyed along the Central Avenue Ditch for approximately 1 400 feet where it will enter a rock lined channel and eventually discharge to South Walnut Creek and Pond B 5

SECTION 7 0

ENVIRONMENTAL EFFECTS OF THE PROPOSED INTERIM REMEDIAL ACTION

Environmental and human health impacts associated with the proposed interim remedial action are evaluated in this chapter Environmental impacts to air quality water quality terrestrial features and short and long term land productivity are discussed in Section 7 1 7 2 7 3 and 7 4 respectively Exposure risks from both routine operations and accidents are analyzed in detail in Sections 7 5 and 7 6 These analyses evaluate risk to workers involved in the interim action other RFP site employees and the general public Commitment of resources transportation impacts and cumulative impacts are discussed in Sections 7 7 through 7 9

7 1 AIR QUALITY

There are three potential air quality impacts associated with the proposed interim remedial action to selectively collect and treat ground water from alluvial and bedrock wells located at Operable Unit 2

1 Potential volatile organic chemicals released from exposed contaminated liquids during construction activities (e g well drilling excavation) or at groundwater collection storage and treatment locations as part of normal operations or accident conditions

2 Fugitive dusts and fossil fuel consumption related exhausts resulting from activities such as excavation construction operations maintenance and monitoring

3 Water treatment process off gases released to the environment as part of normal operations or accident conditions

Air quality impacts from VOCs released during construction activities (e g excavation) will be small when compared to the normal operational activity at Rocky Flats Plant Trace amounts of volatile organics may be released to the atmosphere while over drilling the existing monitoring wells The amount of VOCs released during this construction activity will not cause measurable changes in the ambient air quality VOC concentrations in soils at Operable Unit 2 are insignificant when compared to VOC concentrations in ground water

Consequently normal construction activities and excavation for buried piping/utilities and the treatment building pad are not expected to release VOCs to the atmosphere Preliminary characterization based on the Phase I RI Report indicates the presence of elevated concentrations of semi volatile organic chemicals (phthalates) in the soil Any airborne releases of semi volatile organic chemicals will be from fugitive dust associated with construction activities and will be controlled as discussed below

Dust associated with construction and operational activities will be controlled as specified in the Job Safety Analysis (JSA) procedures The JSA is a process developed from the Rocky Flats Health and Safety policy The JSA addresses health and safety protection of outside contractors and is administered by the Health Safety and Environment (HS&E) Department The initial step of the process involves describing each construction task identifying potential hazards and determining the steps to control hazards This review is evaluated and must be approved by the HS&E Department Upon approval of the JSA the contractor is briefed and assigned a RFP construction engineer This engineer is responsible for construction and arranges for health and safety training of the contractor This training requires an understanding of the hazards and controls associated with the construction tasks The HS&E Department will then issue a renewable one week permit conditional on the workers being briefed and understanding the safety concerns of the construction effort The construction is monitored by the HS&E Department for contractor adherence to the JSA Exposure to and inadvertent ingestion of airborne radioactivity and semi volatile organic chemicals on fugitive dust is analyzed in Section 7 5 Personnel Exposure Pollution from engine emissions fugitive dust generation by vehicles and particulates from tire wear are analyzed separately in Section 7 8 Transportation Impacts.

Collected contaminated groundwater will be processed at the proposed treatment facility The aggregate amount of off gases from the proposed granular activated carbon treatment system will not cause measurable changes in the levels of these gases in the ambient air

Ion exchange columns incorporated into the water treatment process to remove inorganic material and metals will not contribute to off gases either during normal operation or during resin regeneration operations Minor leaks of liquid used for resin regeneration and resins exposed to the air during resin bed charging may contribute to odors within the confines of the water treatment building and will be controlled by adequate ventilation These will not be noticeable from outside the building nor are they a hazard to workers in the building under normal circumstances Spills of resin regeneration chemicals that might be involved in accident conditions will be administratively controlled by actions specified in the Operational Safety Analysis (OSA)

The OSA addresses health and safety concerns originating from routine site operations It is similar to the JSA in that health safety and environmental hazards are identified and evaluated for control This analysis is also reviewed by and must be approved by the HS&E Department Training is required prior to operation with oversight and monitoring by the HS&E Department

7 2 WATER QUALITY

Impacts to water quality arising from the proposed interim action could result from surface runoff entering utility excavations and soil entrainment (sediment transport) by surface runoff ending in open waters

Some excavation will occur in soils that are expected to have measurable levels of semi volatile organic chemicals primarily phthalates Because phthalates adsorb to the soil particles and thus are not transferred from the soil to water in measurable quantities surface water runoff should not cause a water quality concern as long as erosion control measures are applied to all soils excavated during the remedial action

Soils surrounding the 903 Drum Storage and 903 Pad Lip sites are contaminated with plutonium and americium Prior to construction work surveys will be performed to detect the presence of elevated radioactive contamination Elevated radioactive contamination will be handled in accordance with the JSA procedures

For ion exchange treatment the greatest potential for water quality impacts result from chemicals involved with the periodic regeneration of the resins Handling of the concentrated ion exchange regeneration chemicals will be governed by the Operational Safety Analysis as will the precautions for handling the waste brine and transportation of the waste brine to the treatment facility Procedures will be established to assure that waste brine from resin regeneration is segregated from the treated ground water

Waste brine generated during resin regeneration operations will be transported to an evaporator in another facility on the RFP site (Building 374) This waste is similar to other liquid wastes generated at RFP that are treated at the existing evaporator as discussed in Section 2 7 3 of the RFP Final Environmental Impact Statement (FEIS) (DOE 1980) and involves no unique hazards or concerns for workers The volume of waste brine involved estimated at 1 5 to 2 5 percent of total treated volume will not be a major addition to those wastes already processed by the Building 374 evaporator treatment facility The collection transport and treatment of waste brine will be in accordance with standard plant operating procedures and does not present a significant hazard to on site or off site water quality

7 3 TERRESTRIAL IMPACTS

Terrestrial environment features which may be impacted include animal life plant life and land form These impacts are expected to be minimal since the areas of concern have been previously disturbed during the past 37 years since the plant was constructed These past disturbances have left the 903 Pad with an asphalt pad cap and the East Trenches Area has surface evidence of burial trenches The impacts from the IM/IRA will not significantly impact the already disturbed areas

Excavation for the treatment facility building pad influent and effluent piping and utilities will be locally destructive to the vegetation and ground dwelling rodents and insects The disturbed area involved will be small compared to the total surface area of the Operable Unit 2 None of the potentially affected rodents insects or vegetation in the disturbed areas are threatened or endangered species

The proposed interim action will intercept colluvial ground water flow from the Woman Creek drainage basin Wetlands within the South Interceptor Ditch are not expected to be affected since runoff from the Plant is already routed into the Ditch and provides a water supply for the wetlands Water flowing in the South Interceptor Ditch adds to the Woman Creek flow via infiltration No impacts to the flow of Woman Creek are expected

The proposed action will also draw water from bedrock situated under the South Walnut Creek and Woman Creek drainages This action is not expected to have terrestrial impacts such as a change in the flora of South Walnut Creek The wetlands of Woman Creek and the South Interceptor Ditch will not be impacted In summary it has been determined that there will be no significant impacts to wetlands if these parameters are maintained

Treated water from the treatment facility will be discharged into South Walnut Creek and contained by Pond B 5 The maximum flow rate from the treatment facility is anticipated to be 30 gpm for a 24 hour period (43 200 gallons/day) Care will be used in discharging the treated water in a manner not to destroy containment structures which contribute significantly to the basin recharge

The South Walnut Creek basin contains a series of five on channel reservoirs The last pond in the series Pond B 5 discharges directly to South Walnut Creek Water is managed in these ponds and discharged in accordance with the NPDES Permit Discharged water follows the South Walnut Creek drainage north to the natural Walnut Creek drainage Surface water flows in sections of Walnut Creek are currently diverted around the Great Western Reservoir a drinking water source for the city of Broomfield and then returned to the natural drainage channel

7 4 SHORT AND LONG TERM LAND PRODUCTIVITY

Land within Operable Unit 2 is currently undeveloped and will remain so for the foreseeable future as part of the Rocky Flats Plant Operable Unit 2 lies within the security boundaries and is not accessible to the general public

7 5 PERSONNEL EXPOSURES ROUTINE OPERATIONS

The effects of personnel exposures to hazardous chemicals have been estimated in terms of increased risks to individuals of either developing cancer (carcinogenic risk) or developing some other adverse health effect due to the exposure (noncarcinogenic risk) Analyses were done separately for those directly involved in remedial actions (workers) other Rocky Flats Plant personnel not directly involved in remedial actions (site employees) and off site individuals (general public)

Estimates of carcinogenic risks were calculated for each of the organic chemicals identified in Table 4 2 and the individual risks summed for a total carcinogenic risk The carcinogenic risks are considered to be cumulative for the entire period of exposure and the calculations yield an estimate for the lifetime increased risk of cancer

Noncarcinogenic risks are considered threshold events That is no effect is observed below a given exposure Increased risks are based on the average long term exposure (chronic exposure) and are not cumulative over the exposure period Exposure levels were averaged over the period of the release or over one year (whichever was shorter) for each of the selected chemicals through each pathway These levels were evaluated by comparing predicted daily contaminant intakes to the Health Effects Criterion (HEC) (the daily exposure level below which no adverse health effects are expected to occur) HECs used in this report are

Reference Doses (RfDs) as developed by the U S Environmental Protection Agency or a calculated equivalent if no RfD has been adopted by the EPA

Exposures to site employees and members of the general public were analyzed based on a single hypothetical individual for each exposure category Site employees were assumed to be assigned eight hours a day for the duration of the release to whatever building would receive the greatest average airborne exposure The analysis of the impact on the general public assumed a single individual would remain at the point of highest exposure accessible to the general public for each pathway twenty four hours per day for the entire duration of the release These calculations provide an upper bound for the increased risks to each of these groups During the remedial action it is unlikely that any worker site employee or member of the general public would exceed or even approach the risks estimated for their respective group

In calculations of the estimated increased risks to members of the general public from hazardous chemicals the impacts on infants and young children were calculated separately from those on adult members of the population Infants and young children differ from adults in the rate of uptake of the hazardous chemicals and in body weight Both of these factors influence the calculations of increased risk To assess noncarcinogenic risks exposures to the chemicals were estimated for both children and adults and compared with the HEC The numbers quoted in the text of this document are those for the group with the greatest increased risk Carcinogenic risks to a member of the general public were estimated assuming exposure for the entire length of the release which was assumed to be thirty years Two exposure categories were considered one where the member of the public is already an adult when the project starts and the other where the individual is assumed to be a child for the first five years of remedial action and an adult for the remaining 25 years The numbers in the report represent whichever analysis yielded the highest increased risk of cancer

The intake of radioactive materials has been assessed by calculating total intake by individuals and converting that to Committed Effective Dose Equivalent (CEDE) using the exposure to dose conversion factors for inhalation (Table 2 1 of EPA 1988b) Internal Dose Conversion Factors for Calculation of Dose to the Public, Part 2 (DOE 1988a) was used to assess doses to the public The calculated values for CEDE are then compared with the DOE limits of 5 rem per year for workers (DOE 1988b) and 100 mrem per year for members of the general public (DOE 1989)

7 5 1 Worker Exposure Risks

Workers involved in the installation of collection facilities and those involved in operation of the facilities associated with the remedial action may experience increased risks through several pathways

1. Airborne exposure to volatile organic chemicals (VOCs) near construction activities equipment installation or within the facility
2. Dermal exposure to organic and inorganic chemicals or radioactive materials especially during construction activities
3. Inhalation of organic chemicals inorganic chemicals or radioactive materials on fugitive dust especially those generated during construction activities

Airborne Exposures to VOCs

The treatment facility and the piping to and from the treatment facility will be located outside all existing SWMUs to avoid to the degree possible soil contaminated with VOCs There will be monitoring to assess possible exposures to VOCs during these construction activities Protective measures appropriate for the level of VOCs detected will be specified in the Job Safety Analysis to protect the workers

Groundwater will be collected from newly installed wells During drilling of the new wells the damp soil removed during drilling (roughly two cubic feet) may be contaminated by VOCs Because the soil will be exposed in an unconfined area any VOC exposure to the air will be small This soil will be sampled and treated as a RCRA mixed waste until determined otherwise Sampling will be done during well installation and protective measures appropriate for the level of VOCs detected will be specified in the Job Safety Analysis to protect the workers

The potential for chronic or routine exposure of workers to VOCs will be small involving such things as sampling and analysis Building ventilation will be used to prevent the buildup of VOC vapors in the work environment Activities that might lead to nonroutine exposures such as opening tanks or other maintenance operations will be of short duration and will not lead to chronic exposures Personnel and ambient air monitoring will be performed to assure adequate levels of personnel protection

Dermal Exposures

Neither inorganic chemicals nor any of the radioactive materials identified in the work areas are absorbed through the skin The uptake from this pathway will be negligible During construction activities for the proposed action there will be little or no potential for dermal contact with soil contaminated with VOCs The water treatment facility will be constructed on non VOC contaminated soil The discharge piping from the water treatment facility will be routed through uncontaminated soil All the collection piping except that immediately adjacent to new wells near the present location of wells 1 71 2 71 and 1 74 also will be routed through soil not contaminated with VOCs All three of these wells will be located very close to the edge of the SWMUs so only very limited piping installation will be within identified contaminated soil

Personal protective measures may be necessary during some routine activities where there is a potential for contact with contaminated water such as during well installation or routine water sampling in the treatment facility If such measures are necessary for the protection of the workers they will be specified in the JSA or Operational Safety Analysis for those activities

Inhalation of Fugitive Dust

Inhalation of VOC vapors was considered in a previous paragraph of this section of the report The levels of metals in the soil are not sufficient to create a hazard from inhalation of fugitive dust

Both plutonium and americium have been identified in soil samples from the Operable Unit 2 The sampling suggests that both radionuclides appear to be near the surface of the soil Installation of new wells the water collection systems and construction of the water treatment facility will create some respirable dust that may include plutonium and americium contamination Worker exposure to radioactivity from fugitive dust will be monitored and controlled during construction by the JSA and during operation by the OSA

7 5 2 Site Employee Exposure Risks

Other workers at the RFP site could be exposed to low levels of VOC vapors released during normal operation and to fugitive dust generated both during installation and operation of the facilities used in the proposed interim action

Potential VOC releases from the influent equalization tank vents and the treatment facility building will be controlled by activated carbon filters on the tank vents and building exhaust The activated carbon treatment system is designed to remove VOCs to below detect able levels so there will be no measurable VOC releases from the discharge of the decarbonator or from the vents of the effluent storage tanks

Installation of new wells may be expected to produce small volumes (roughly two cubic feet) of soil containing water contaminated with VOCs Because the volume of soil is low the amount of VOCs released to the air will not contribute to the exposure of other site workers

Inhalation of fugitive dust contaminated with plutonium and americium is also a potential source of increased risk for other RFP site workers There is the potential for creation of such dust during both construction activities and certain operational activities

During construction trenches will be excavated for the piping from the individual wells to the treatment facility Although the routing of the trenches will be planned to avoid all identified SWMUs the surface soil outside the SWMUs does contain plutonium and americium The airborne dust created by the excavation activities is a potential source of exposure for other site workers The highest effective dose to other site workers from all excavation work during the project would be less than 0 0002 mrem to any individual which is very low compared with the 125 mrem average dose in the United States from natural background sources Other construction activities such as drilling new wells and the movement of construction equipment also would generate dust but at lower levels than the excavation activities Doses from these other construction activities would be similarly low

Unlike the construction activities that are of limited duration operational activities that might generate respirable dust would continue for the lifetime of the interim action The principal such action would involve inspection of the wells and pumps Access to these wells would require vehicular travel over unpaved roads An estimate was made of the radiation dose from inhaling the dust generated by this sort of activity assuming a daily inspection conducted five days a week throughout the duration of the interim action The annual effective dose to any other individual site worker from such dust would be less than 0 3 mrem This is very small when compared with 125 mrem per year the average dose from natural background sources

7 5 3 Risks from Exposure to Members of the Public[1]

Members of the public would be exposed to the same sources of risk as described in the previous section for other RFP site workers The concentration of the VOCs or fugitive dust would be less for members of the public because the dispersion distance from the source to the closest site boundary is greater than the dispersion distance assumed for the site workers

The public also may be exposed to fugitive dust containing plutonium or americium generated during the construction phases of the interim action Doses to the public were analyzed for the two sources of dust discussed in Section 7 5 2 above The maximum effective dose to a member of the general public from dust generated during construction activities would be about 0 003 mrem The doses from dust generated during vehicular travel for daily inspection of the wells and pumps would add less than 0 006 mrem per year These are both low compared with the dose from natural sources of radioactivity in the environment (about 125 mrem per year) or to the DOE guidelines of 100 mrem per year to any member of the general public (DOE 1989)

7 6 PERSONNEL EXPOSURES ACCIDENTS

Any accidents that may occur during the construction phase of the proposed action are those typical of small excavation or construction activities While such an accident may lead to personnel exposure to contaminated groundwater or soil none of the hazardous materials have been identified in concentrations immediately dangerous to health The Job Safety Analysis will identify preventive/corrective actions and the parties responsible for each basic job Workers will be familiar with the JSA and a copy of it will be available at the work site No credible accident during construction would lead to exposure of either workers site

1 Throughout this report the t rm gen ral public has a special and very restricted meaning In order to estimate the maximum exposure or risk to any individual outside of th RFP site all estimates are based on exposure to a person at the sit boundary location having the highest average airborne concentration who remains there for 24 hours each day 365 days ach year for the duration of th operation or the remedial action

employees or members of the public to levels greater than those described in the next paragraph

During operation accidents that could impact either workers or members of the public would include fires or major spills of contaminated material Because all the hazardous material is treated in water without increasing contamination concentration fires would be an industrial hazard but would not produce airborne releases that would be greater than those caused by a major spill

Spills of untreated water within the treatment building would create the potential for short duration airborne VOCs Uptake of contaminants by workers involved in the cleanup would be controlled by following safety precautions specified in the Operational Safety Analysis Airborne releases through ventilation systems that could lead to exposures of other RFP employees (site employees) or the general public are controlled by charcoal filters on the ventilation exhaust

The most severe credible accident with potential for the exposure of either site employees or the public would be airborne VOCs released with the rupture of one of the 21 000 gallon water influent tanks The analysis of this hypothetical accident indicates the total increase in carcinogenic risk to the maximally exposed member of the public to be less than 4 x 10^{10} or about four hundredths of one percent of the level considered significant by the EPA The total increase in the noncarcinogenic risks would be about 3 x 10^{3} or about three tenths of one percent of the level considered significant by the EPA For other site workers the carcinogenic risks would be about 8 x 10^{9} (less than one tenth of a level the EPA considers significant) The noncarcinogenic risks to other site workers would be 0 01 (one percent of the level the EPA would consider significant) if no efforts were made to evacuate or otherwise protect the workers downwind of the spill

7 7 COMMITMENT OF RESOURCES

The scope of the proposed action is small and the resources (material/manpower) for construction and operation will likewise be small No significant commitments of valuable resources are involved

With the exception of the land area all of the construction and operation related material will be irrevocably and irretrievably committed to the implementation of the remedial action Most of these resources are normally consumed at the plant at a rate which makes the requirements of the remedial action insignificant Ion exchange resins are similar to resins and chemicals already in use at the RFP The resins and regeneration chemicals are readily available from off site sources Their consumption will not be the cause of shortages in the business community The anticipated usage of granular activated carbon resins and regeneration chemicals will be well within local supplies

7 8 TRANSPORTATION IMPACTS

Human health impacts normally incident to transportation include latent effects associated with vehicle pollution in addition to traumatic injuries and fatalities resulting from accidents

Normal transportation is associated with incremental pollution from engine emissions fugitive dust generation in the vehicle s wake and particulates from tire wear The table below presents estimates of risk resulting from truck transportation (Rao 1982)

		Health Effects per Kilometer		
Source	Mode	LCFs*	Injuries	Fatalities
Pollutants	Truck	1 0 E 7 (urban only)		
Accidents	Truck		5 1 E 7	3 0 E 8

LCFs represent latent cancer fatalities resulting from incremental vehicle pollution and would occur after some latency period following initial exposure

Uncertainties are associated with pollution emission rates and atmospheric dispersion behavior To compensate for these uncertainties the analysis utilized conservative estimates for determining pollution health effects The tabulated accident impacts are average values over all population zones (urban suburban rural) and are derived from Department of Transportation nationwide statistics

The proposed action will involve transportation activities during the construction phase as well as during subsequent operation All construction shipments are anticipated to be by truck and originate within the Denver metropolitan area within a 50 mile radius of the plant site Materials to be brought on site include the treatment system storage tanks piping concrete steel building materials and associated equipment The delivery of these materials will require several truckloads over the construction period followed by routine transport truck travel between collection tanks and the treatment facility estimated at 32 kilometers (20 miles) per week The resulting transportation impacts will be small as seen from the tabulated health effect estimates (Rao 1982) To place transportation impacts to the general public in perspective it is observed that approximately 60 000 round trip truck shipments (one way distance of 50 miles) would be required to cause one additional latent cancer fatality An average of 210 000 truck shipments would be required to result in one additional traumatic fatality The increase in site traffic will be noticeable but will be of short duration External to the plant boundary the increase in traffic level will not be noticeable

Treatment of contaminated ground water from the Operable Unit 2 will result in an incremental increase in the delivery of granular activated carbon Deliveries will be spread out over the course of the year and will likely be handled by one of the existing plant chemical suppliers The very small number of shipments involved will result in an insignificant impact to human health Normal operation will also involve periodic delivery of regeneration chemicals for the ion exchange resins and possibly infrequent shipments of replacement resins It is expected that the number of shipments required will be small and will result in an insignificant impact to human health

Operational activities will also involve periodic inspection of the ground water collection wells and pumps This will require vehicular travel to each source well which is estimated to total 20 miles per week (1 040 miles per year) Impacts to human health (latent cancer fatalities from vehicle pollution) will be negligible

7 9 CUMULATIVE IMPACTS

Routine water processing arising from the treatment of VOCs will not create noticeable increases in solid wastes All gaseous releases will be undetectable off site None of the materials that may be released are expected to be concentrated by any natural process Therefore releases from water treatment will not add to any other plant releases to have a cumulative effect

The reprocessing of ion exchange resin regeneration waste brine will cause an increased load on the evaporator at Building 374 Additional evaporator solids will be generated Neither effect however is great compared to the current loading and output of the evaporator nor are the types of liquids input or solids output expected to be noticeably impacted When the resins need to be replaced or removed at the completion of processing they will add a very small amount to the current solid waste volumes Any radionuclide accumulation on the resins is not expected to exceed exempt quantities by weight so shipment of the exhausted resins if that is required is not expected to cause any special concerns or require special controls

It is estimated that two workers will be involved in routine operation and maintenance of the water treatment facility This will have a negligible impact on the work load of plant personnel In routine operation these workers will not be exposed to any levels of VOCs that would restrict them from other assignments at the Rocky Flats Plant

Construction activities will result in increased vehicular traffic engine emissions and workers The number of personnel required for the proposed action will be a small portion of the assumed yearly additional construction loading

Discharges of treated water into the South Walnut Creek basin would total up to one acre foot per 7 5 days After surface water loss due to percolation and evaporation additional discharges from B 5 Pond will be required These discharges in addition to the current NPDES discharges are not expected to significantly impact Walnut Creek downstream of the B 5 Pond

SECTION 8 0

ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES

Three alternatives to the proposed IM/IRA at the Operable Unit 2 were evaluated for environmental effects The alternatives 1) no action 2) ground water collection from french drains treatment and discharge of treated water into the South Walnut Creek Basin and 3) collecting ground water from well arrays treatment and discharge of treated water into the South Walnut Creek Basin are reviewed in this section for environmental effects Each alternative is evaluated in regard to environmental quality personnel exposure and transportation impacts Following the alternative evaluation Table 8 1 compares the potential impacts of the proposed action with the alternatives

8 1 ENVIRONMENTAL EFFECTS OF NO ACTION

8 1 1 Environmental Quality

The No Action alternative would not involve any short term impact to the environment or work force/general public and would eliminate the need for off site transportation activities However it would not contain remove or destroy volatile organic and inorganic contaminants which pose a long term release risk to the general public and will require remedial actions in the future

The No Action alternative would require that the current semi annual site monitoring be continued Since the monitoring is a part of the existing plant environmental monitoring program the impact on plant operations and the surrounding community would be effectively zero However because off site migration may occur in the future and because Federal and state regulations require remedial action the No Action alternative is unacceptable

8 1 2 Personnel Exposure

The No Action alternative will have minimal impact on current workers at the site or at adjacent sites Workers would be required only for quarterly sampling which would present no additional impacts The source of hazardous material would be neither removed nor controlled Therefore the possibility of releasing contaminated water off site would increase over time The site would then be a source of public exposure in the long term

8 1 3 Transportation

The No Action alternative would incorporate both ground water and surface water monitoring and utilize existing wells No remedial activities would be taken Consequently there would be no on site or off site transportation activities associated with this alternative or related impacts to workers or the general public

8 2 ENVIRONMENTAL EFFECTS OF ALTERNATIVE 2

8 2 1 Environmental Quality

The environmental impacts of this alternative result from removal and disposal of 3 947 cubic yards of potentially contaminated soil piping trenching and delivery of construction materials at the three french drain areas Construction impacts would be destructive to the flora and disruptive to the fauna during the short term The treatment facility impacts would be the same as discussed in the proposed action

Project labor and materials requirements would be small and would be supplied by local sources Until the vegetative cover is re established there may be periods during which pollution of air and surface waters from soil erosion could occur

The construction of subsurface drains is likely to be ineffective in containing and capturing the ground water contaminants in the bedrock as discussed in Section 4 4 2 2

8 2 2 Personnel Exposure

Installation of the drains and trenching would provide for potential worker exposure to VOCs and radioactive fugitive dust During the excavation the workers exposure risk to VOCs released from damp soils and dewatering activities would be elevated Workers would also have a higher radionuclide exposure risk due to disturbing the top soil at these sites during trenching and the initial excavation for the french drains

During operation of the alternative worker s exposure risk to VOCs is increased because of required pump maintenance and cleaning requirements of the subsurface drain system

8 2 3 Transportation

The french drain alternative could potentially have temporary transportation impacts during construction Transportation requirements may require the disposal of 3 947 cubic yards of contaminated soil removed from the trench areas and the delivery of the same amount of material to be used for backfill

8 3 ENVIRONMENTAL EFFECTS OF ALTERNATIVE 3

8 3 1 Environmental Quality

The environmental effects of the construction of three well arrays would be very similar to the french drains alternative except for the potential removal of the large amounts of contaminated soil The well drilling and the installation of piping would require the disposal of contaminated drilling fluids and topsoil removed during trenching required to network the array into a central water collection system Construction impacts would also be temporarily destructive to the flora and fauna of the areas

Both labor and materials would be supplied by local sources with project requirements being very small There may also be periods of air and surface water pollution due to soil erosion until a vegetative cover is restored on the disturbed areas

The construction of the well arrays would be expected to provide the same environmental quality results as the french drain alternative as discussed earlier

8 3 2 Personnel Exposure

The drilling of the wells for the well array would have potential worker exposure to VOCs and radioactive fugitive dust Potential worker exposure is possible during the construction of the well arrays and during maintenance of the pumps and contaminated water collection systems at the three sites This exposure would be expected to be higher than the french drain alternative because of the additional pumps to be installed and maintained

8 3 3 Transportation

The well array alternative would have negligible transportation impacts Transportation requirements are increased slightly during the drilling of the well arrays due to the delivery of materials and personnel

8 4 SUMMARY

The impacts of the alternatives are judged to be small Potential impacts associated with the proposed action and all identified alternatives are compared in Table 8 1

TABLE 8 1

SUMMARY COMPARISON OF POTENTIAL IMPACTS OF PROPOSED ACTION AND ALTERNATIVES

Impact Category	Proposed Action	Alternatives		
	Selective Pumping & Treatment	No Action	French Drains & Treatment	Well Array & Treatment
Environmental Impacts				
Excavation	Pipe Trenching	None	3 947 yd^3	Pipe Trenching
Well Drilling	6	None	None	44
Topographical deformation (permanent)	Treatment Facility	None	Treatment Facility	Treatment Facility
Endangered Species Impacts	None	None	None	None
Wetlands Impacts	None	None	None	None
Cultural Impacts				
Resource	Negligible	Negligible	Small but greater than proposed action	Small
Archaeological Impacts	None	None	None	None
Long Term Considerations				
Remedial Action Period (Institutional Control)	TBD	>30 yrs	TBD	TBD
VOC Contaminant Removal	Limited	No	Limited	Limited
VOC Contaminant Destruction	Limited	No	Limited	Limited
Inorganic Contaminant Removal	Limited	No	Limited	Limited
Exposure of General Public				
Construction	None	None	Negligible (truck shipments)	None
Routine	None	Future Release Risk	None	None
Accident	None	None	None	None

TABLE 8 1 (cont)

SUMMARY COMPARISON OF POTENTIAL IMPACTS OF PROPOSED ACTION AND ALTERNATIVES

Impact Category	Proposed Action	Alternatives		
	Selective Pumping & Treatment	No Action	French Drains & Treatment	Well Array & Treatment
Exposure of Workers				
Construction	Trace VOC vapor exposure during collection system construction some exposure to RAD fugitive dust	None	Negligible dermal exposure to con taminated soils trace VOC vapor exposure higher RAD dust exposure than proposed action	Similar but slightly higher risks as for proposed action, Higher RAD dust exposure than proposed action
Routine	Trace VOC vapor exposure during pump maintenance & facility operations	None	Similar risks as proposed action	Similar but slightly higher risks as for proposed action
Accident	Trace VOC vapor inhalation w/ neg ligible impact	None	Similar risks as proposed action	Similar risks as proposed action
Off site Transportation				
Construction (truckloads)	Minimal	0	535	Minimal
Operation (truckloads/yr)	~12	None	Similar to proposed action	Similar to proposed action
Contaminated Materials (truckloads)	None	None	None	None
Cumulative Impacts to RFP Site	Small	None	Small but greater than proposed action	Small

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SECTION 9 0

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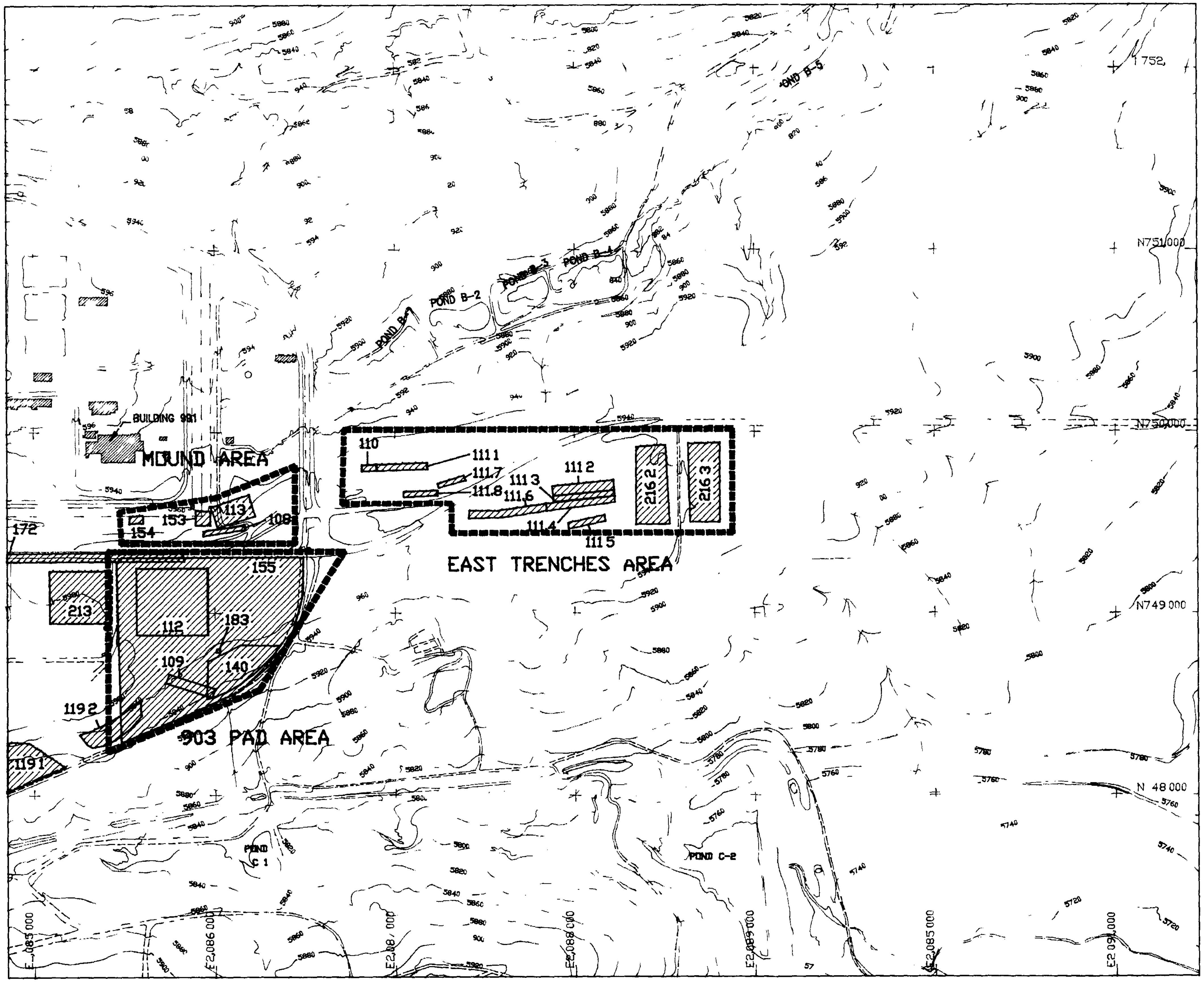


EXPLANATION

1421 — SOLID WASTE MANAGEMENT UNIT AND SWMU DESIGNATION

REMEDIAL INVESTIGATION AREAS

Scale 1 = 600

0' 300' 600'

CONTOUR INTERVAL = 20'

ROCKWELL INTERNATIONAL
Rocky Flats Plant
Golden, Colorado

IM/IRA OPERABLE UNIT 2

FIGURE 2-2

AREA LOCATIONS AND ASSOCIATED SOLID WASTE MANAGEMENT UNITS LOCATIONS

December 1989

RF600L.MB-112789

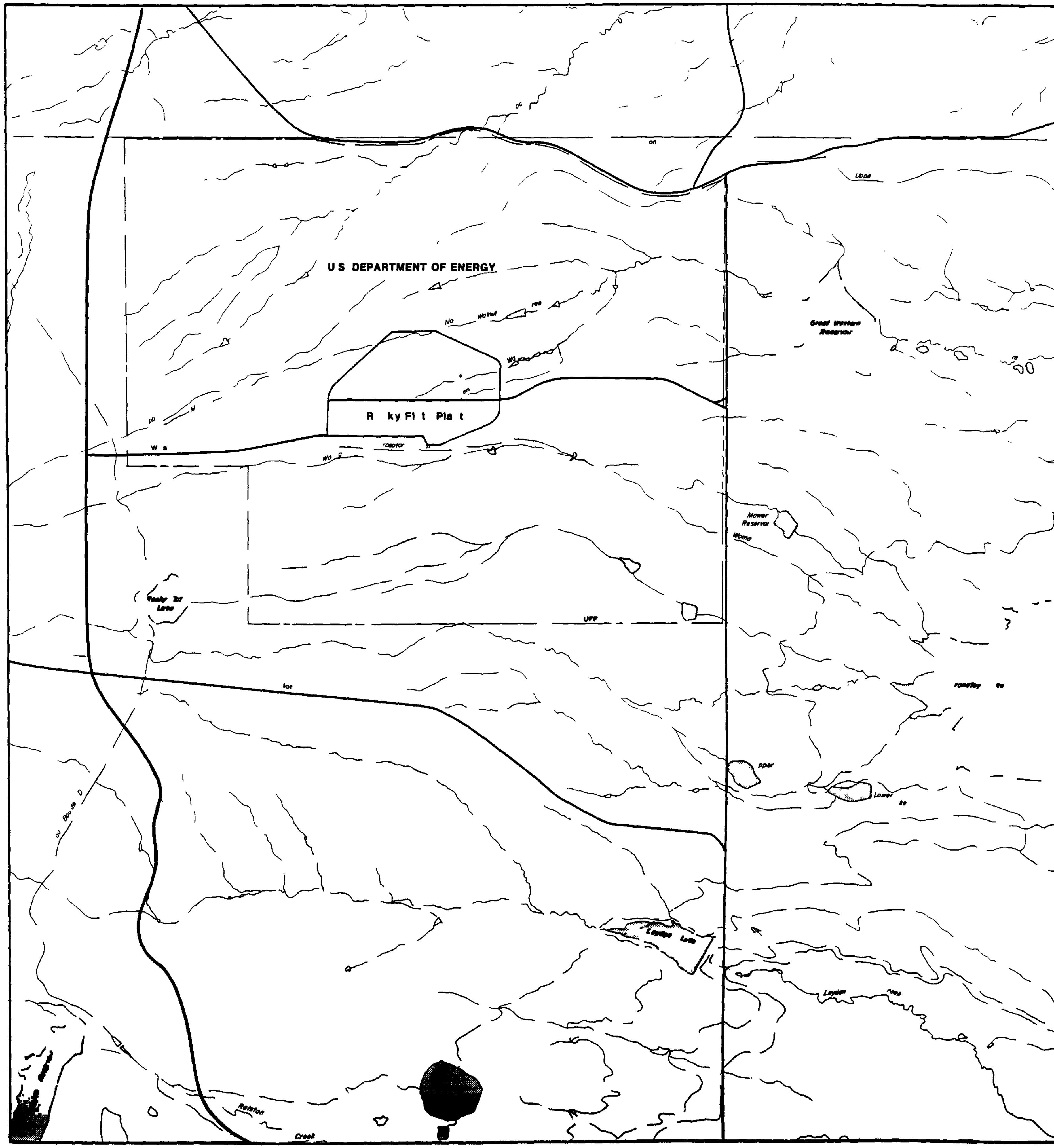
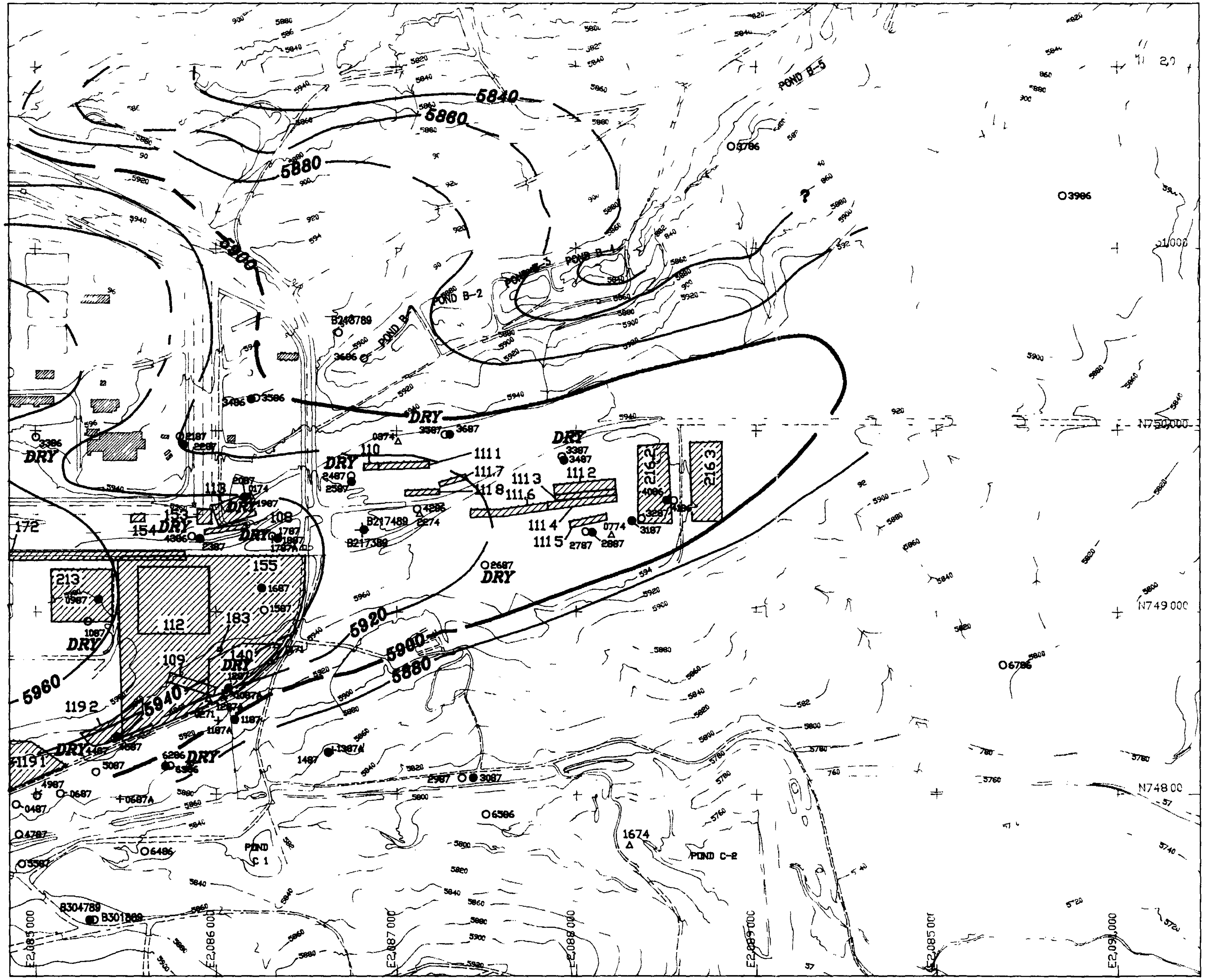


FIGURE 2 4

SURFACE WATER DRAINAGE PATTERNS AT ROCKY FLATS PLANT



EXPLANATION

5798	POTENTIOMETRIC SURFACE ELEVATION (feet above mean sea level)
5860	LINE OF EQUAL POTENTIOMETRIC SURFACE ELEVATION (feet above mean sea level)—DASHED WHERE APPROXIMATELY LOCATED
1421	SOLID WASTE MANAGEMENT UNIT (SWMU) AND SWMU DESIGNATION
B217489 ●	BEDROCK MONITOR WELL
B213789 ○	ALLUVIAL MONITOR WELL
0382 △	PRE-1986 MONITOR WELL
B217389 +	ABANDONED HOLE
PZ1089 □	PROPOSED 1989 WELL

N

Scale 1 = 600

0 300' 600

CONTOUR INTERVAL = 20

ROCKWELL INTERNATIONAL
Rocky Flats Plant
Golden Colorado

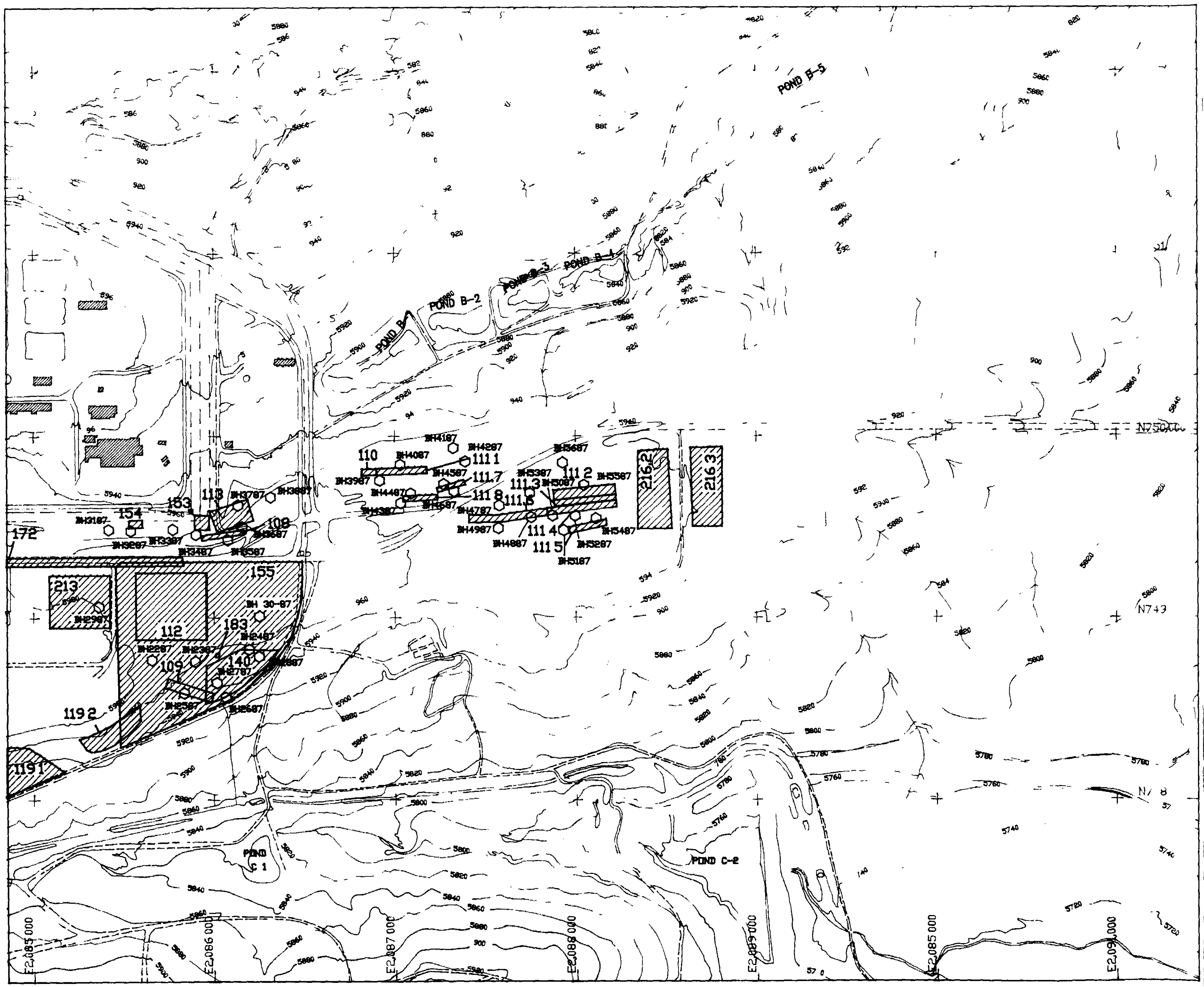
IM/IRA OPERABLE UNIT 2

FIGURE 2-5

CONTOURS OF POTENTIOMETRIC LEVELS OF UPPERMOST GROUND WATER

December 1989

RF600M MB-112789



EXPLANATION

1421 SOLID WASTE MANAGEMENT UNIT (SWMU) AND SWMU DESIGNATION

BH4987 ○ BOREHOLE LOCATION AND IDENTIFICATION

N

Scale 1 = 600

0' 300 600

CONTOUR INTERVAL = 20'

ROCKWELL INTERNATIONAL
Rocky Flats Plant
Golden, Colorado

IM/IRA OPERABLE UNIT 2

FIGURE 2-6

LOCATIONS OF
SOLID WASTE MANAGEMENT UNITS
AND BOREHOLES

December 1989

RF600N.MB

EXPLANATION

1421 SOLID WASTE MANAGEMENT UNIT (SWMU) AND SWMU DESIGNATION

TREATMENT PLANT

2587 RECOVERY WELLS

INFLUENT PIPELINE

EFFLUENT PIPELINE

N

Scale 1 = 600

0' 300' 600'

CONTOUR INTERVAL = 20'

ROCKWELL INTERNATIONAL
Rocky Flats Plant
Golden, Colorado

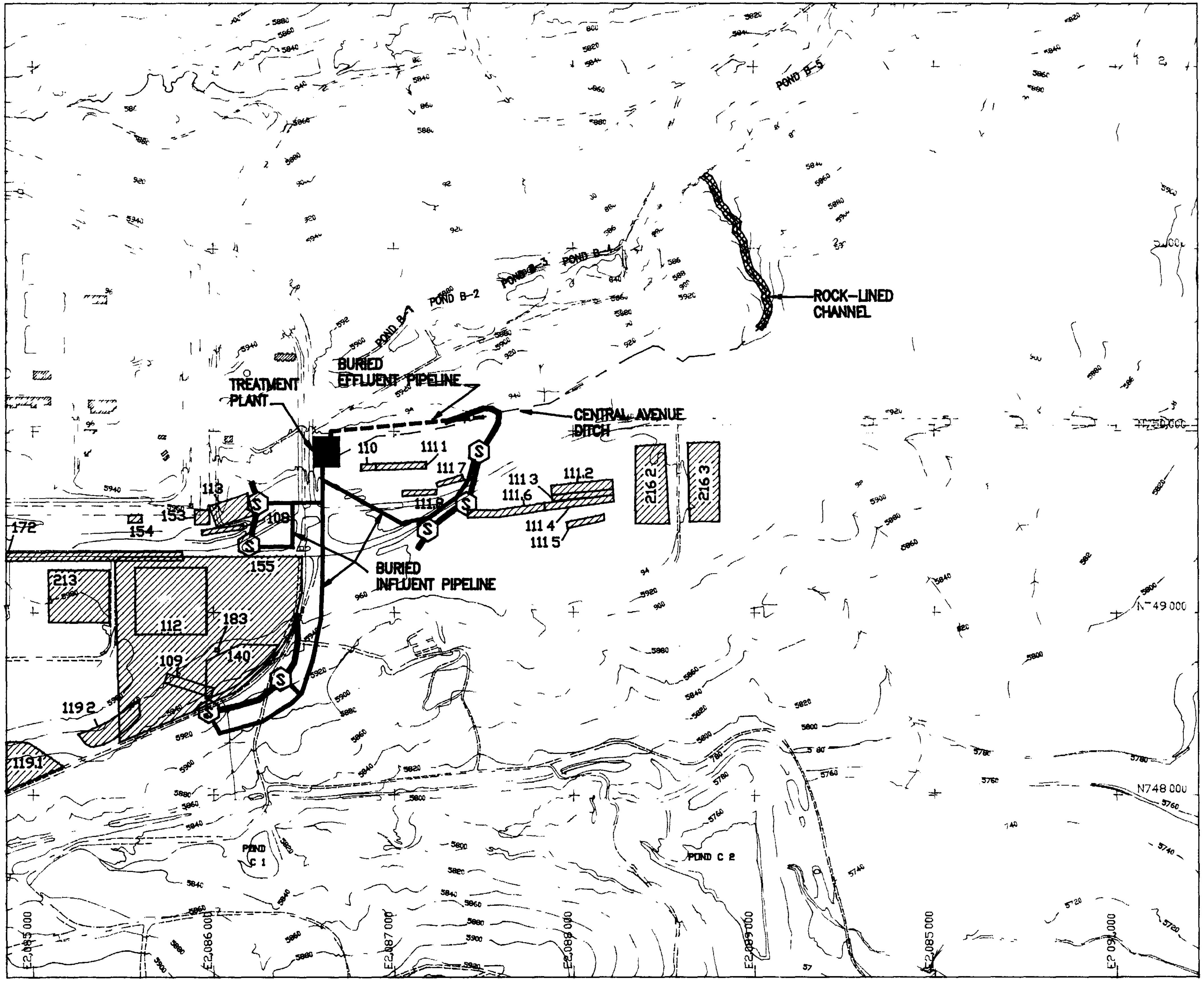
IM/IRA OPERABLE UNIT 2

FIGURE 4-4

ALTERNATIVE 1
SELECTIVE WELL PUMPING

December 1989

RF6000.MB-112789



EXPLANATION

SOLID WASTE MANAGEMENT UNIT (SWMU) AND SWMU DESIGNATION

TREATMENT PLANT

EFFLUENT PIPELINE

INFLUENT PIPELINE

APPROXIMATE FRENCH DRAIN LOCATIONS

SUMPS (LOCATION TO BE FINALIZED DURING DETAIL DESIGN)

Scale 1 = 600

0' 300' 600

CONTOUR INTERVAL = 20'

ROCKWELL INTERNATIONAL
Rocky Flats Plant
Golden, Colorado

IM/IRA OPERABLE UNIT 2

FIGURE 4-7

ALTERNATIVE 2
FRENCH DRAIN LOCATIONS

December 1989

RF600P.MB-112789